

Warner Robins Air Logistics Center Engineering



Aircraft Maintenance Data: Does it Matter?

Panel Session: Reliability Based
Approaches for Design and Sustainment

Russ Alford

WR-ALC/ENFA



Background

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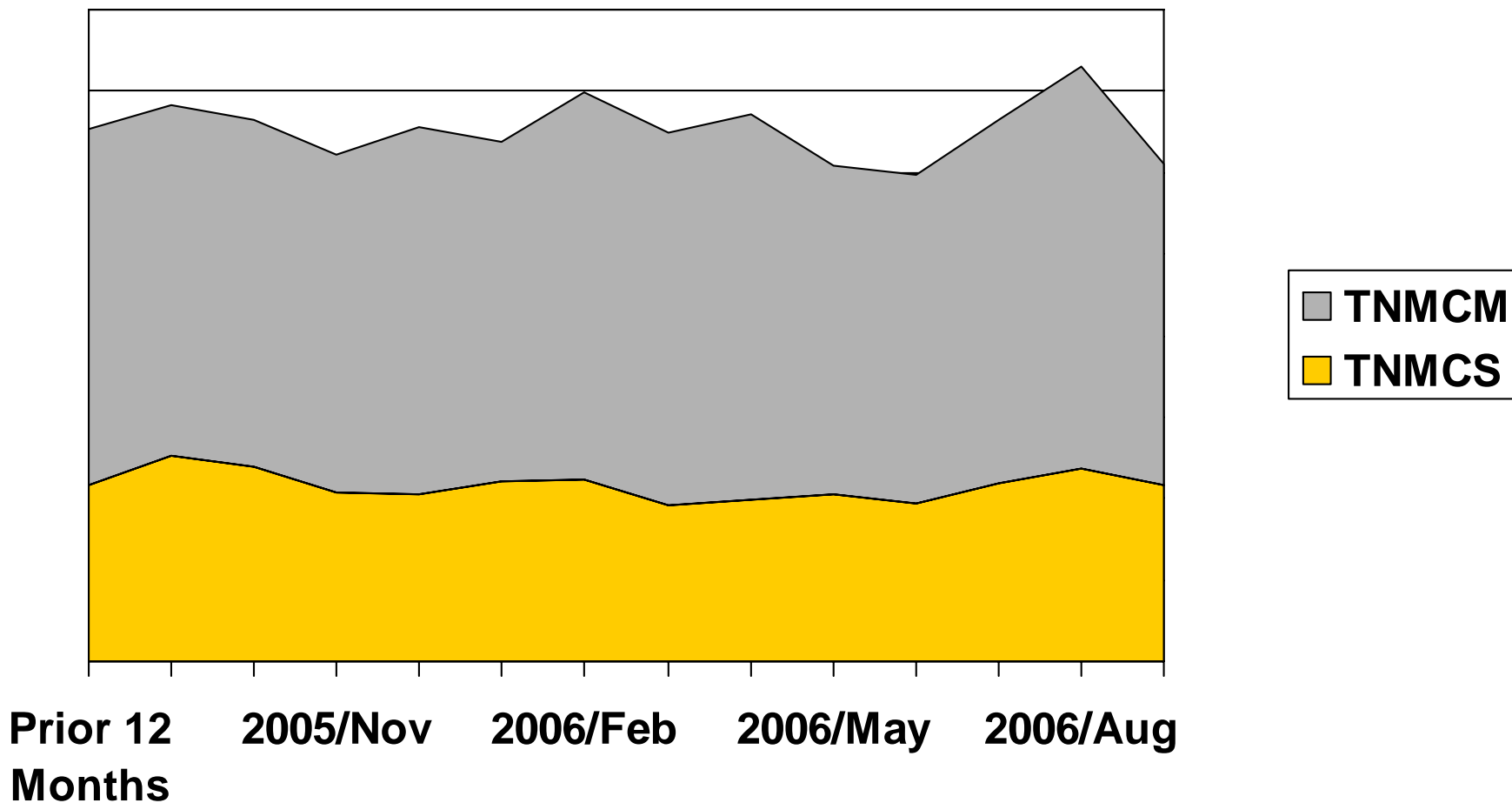
- Following this chart is NMC data for 18 different MDS
 - The first chart for each a/c shows Total Not Mission Capable Supply (TNMCS) and Total Not Mission Capable Maintenance (TNMCM)
 - **TNMCS is the gold area**
 - TNMCM is the gray area
 - The second chart for each a/c shows Not Mission Capable Maintenance Scheduled (NMCMS) and Not Mission Capable Maintenance Unscheduled (NMCMU)
 - **NMCMS is the blue area**
 - **NMCMU is the red area**
- Data from the Air Force Common Operating Picture



Aircraft 1



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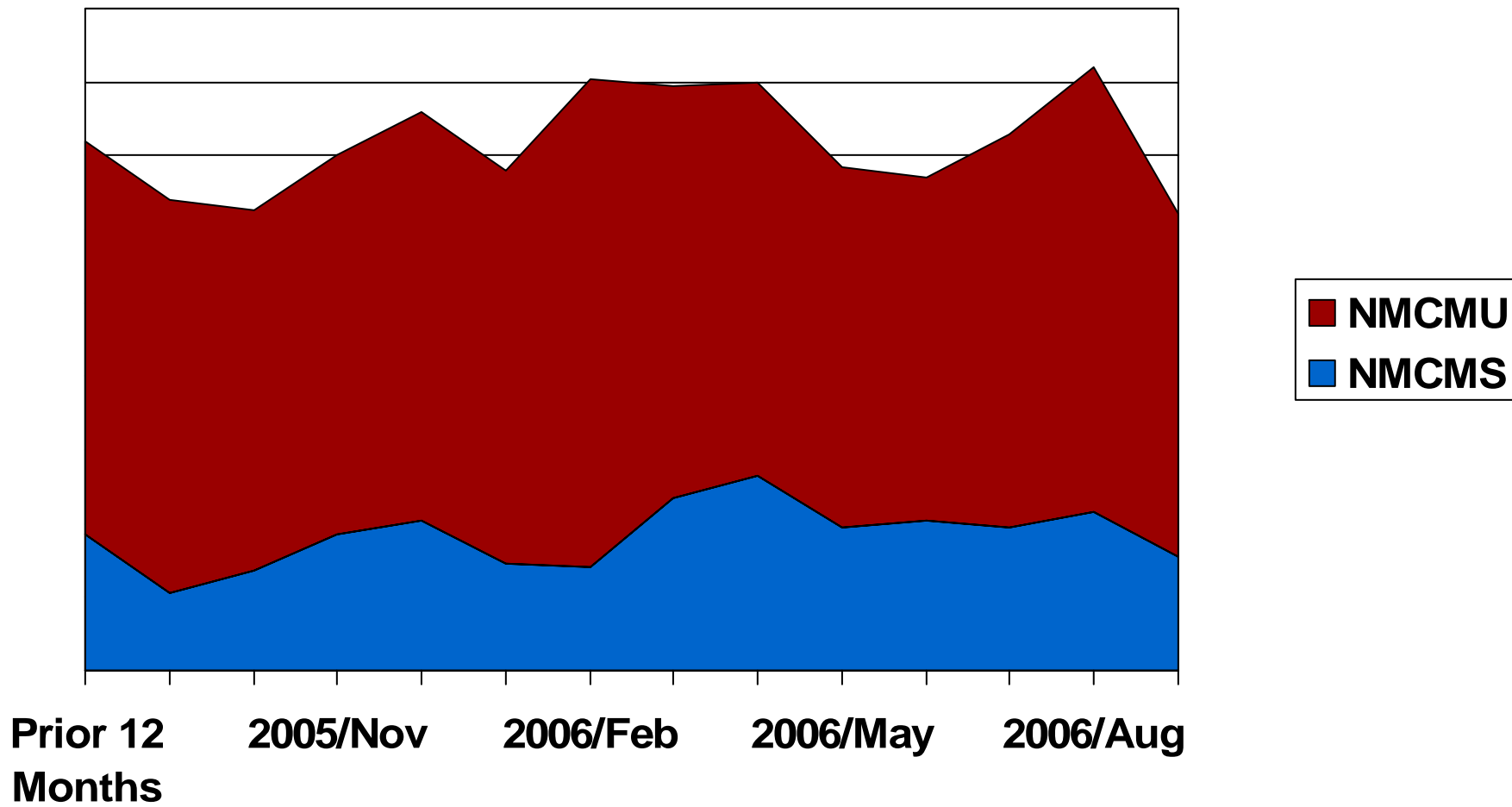




Aircraft 1



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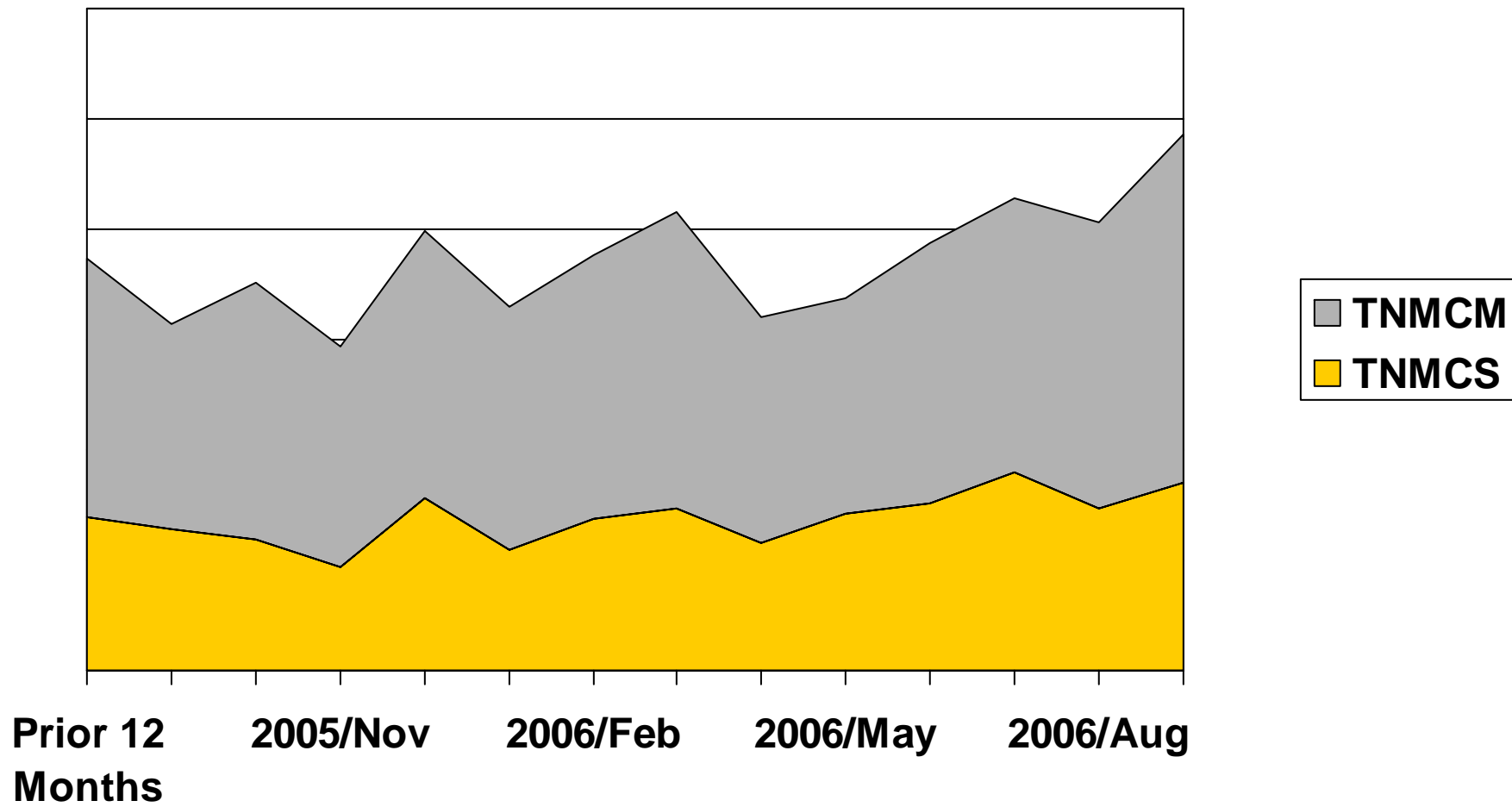




Aircraft 2



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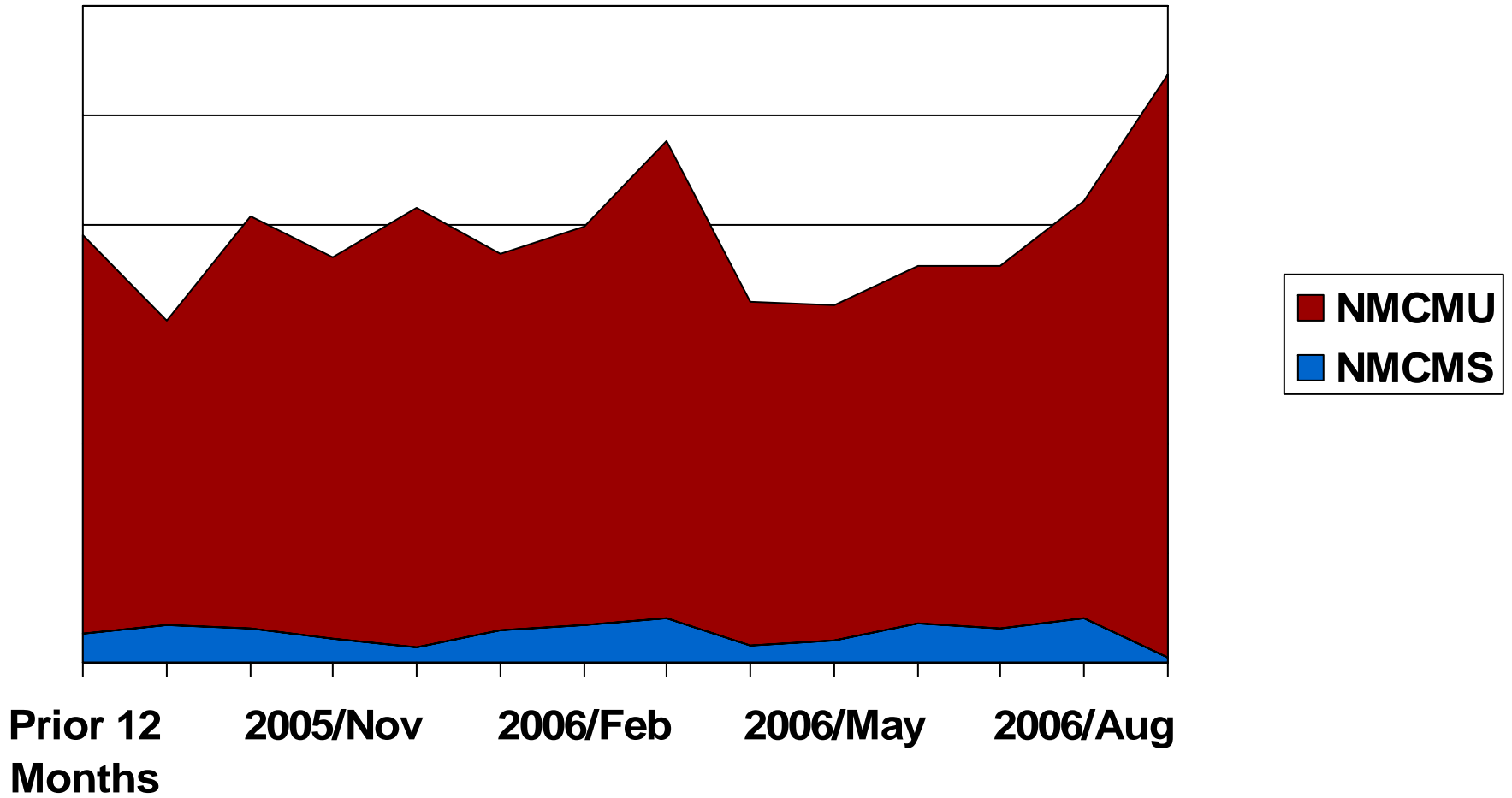




Aircraft 2



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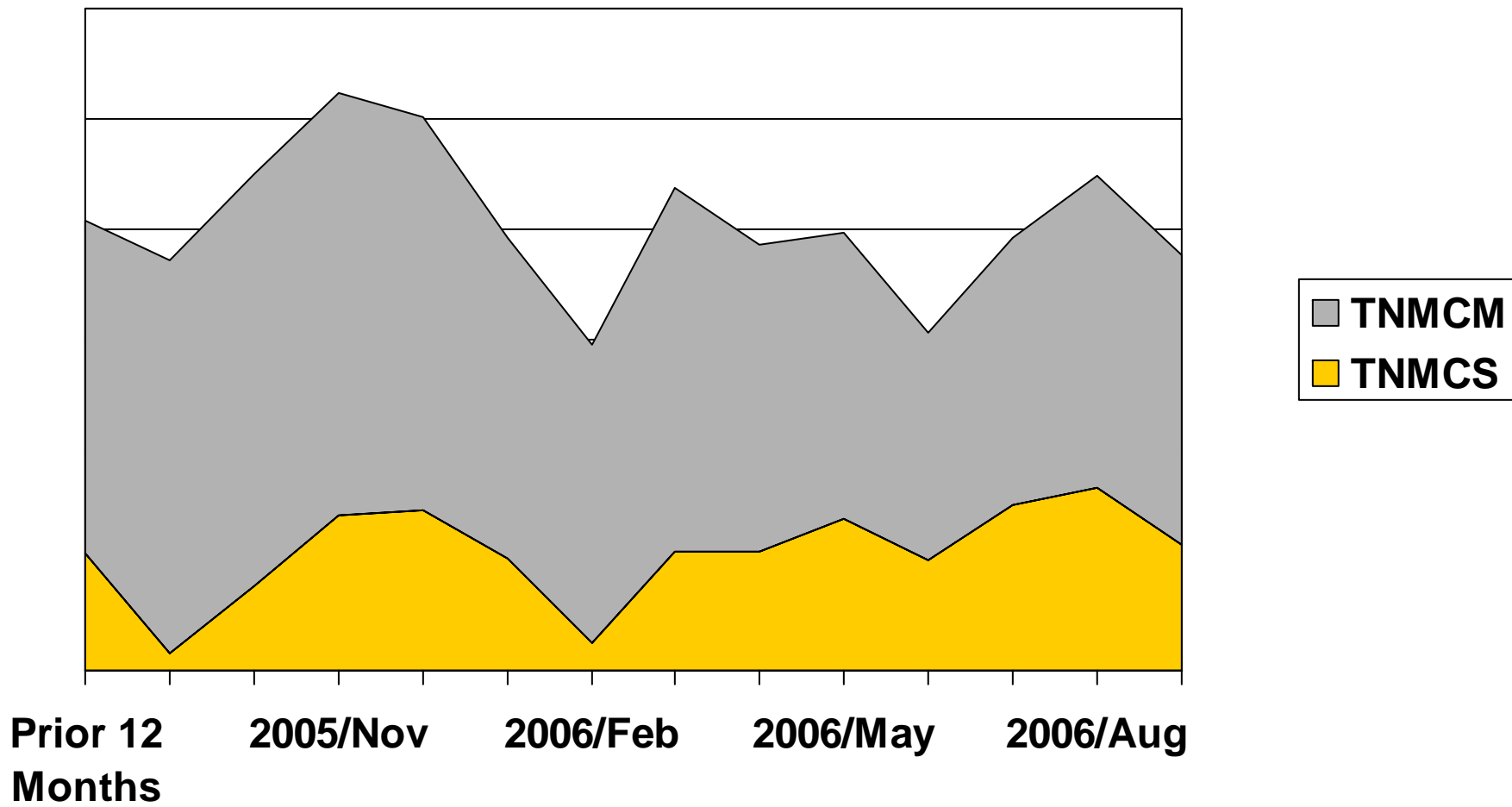




Aircraft 3



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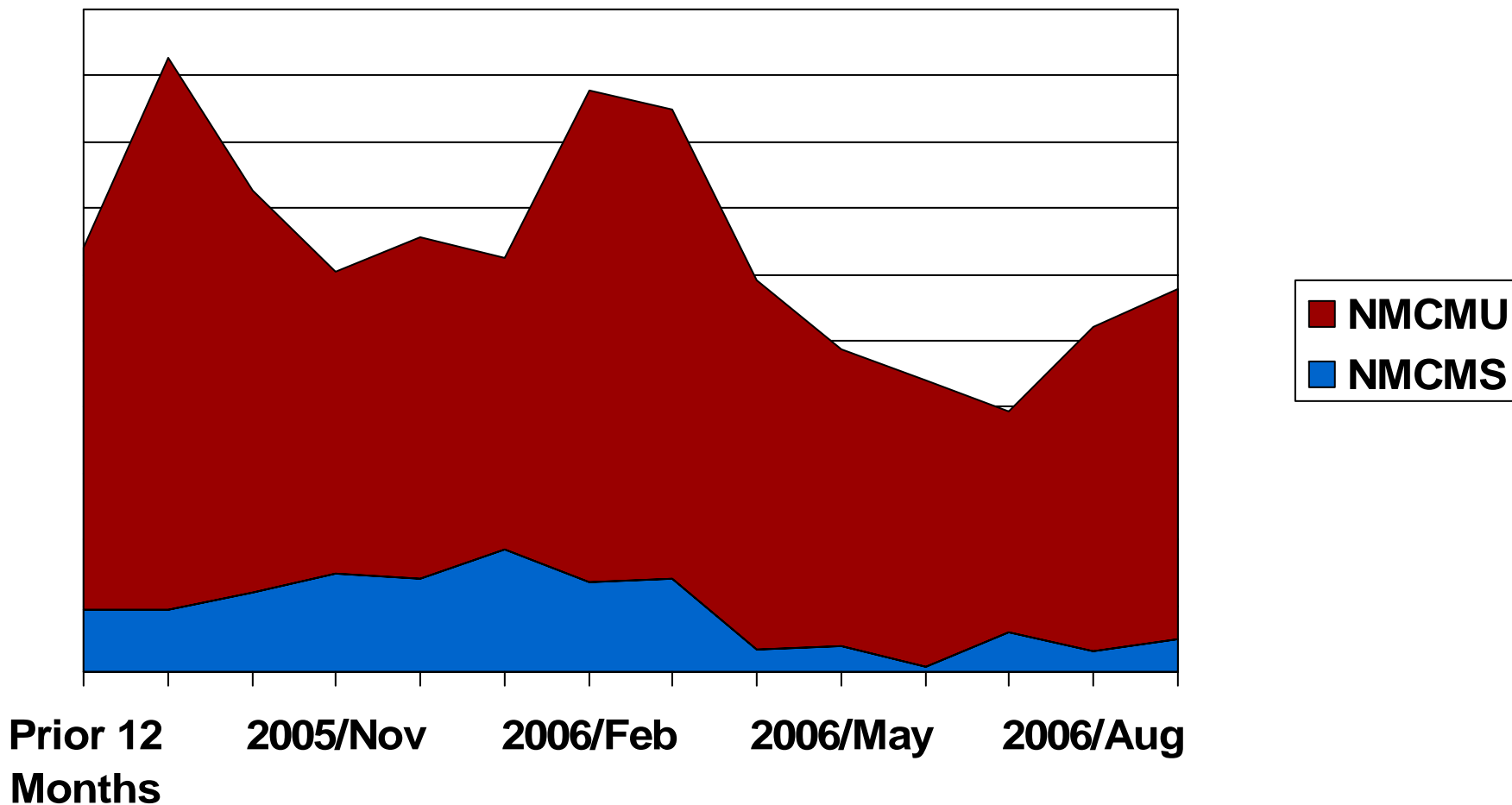




Aircraft 3



Warner Robins Air Logistics Center/EN

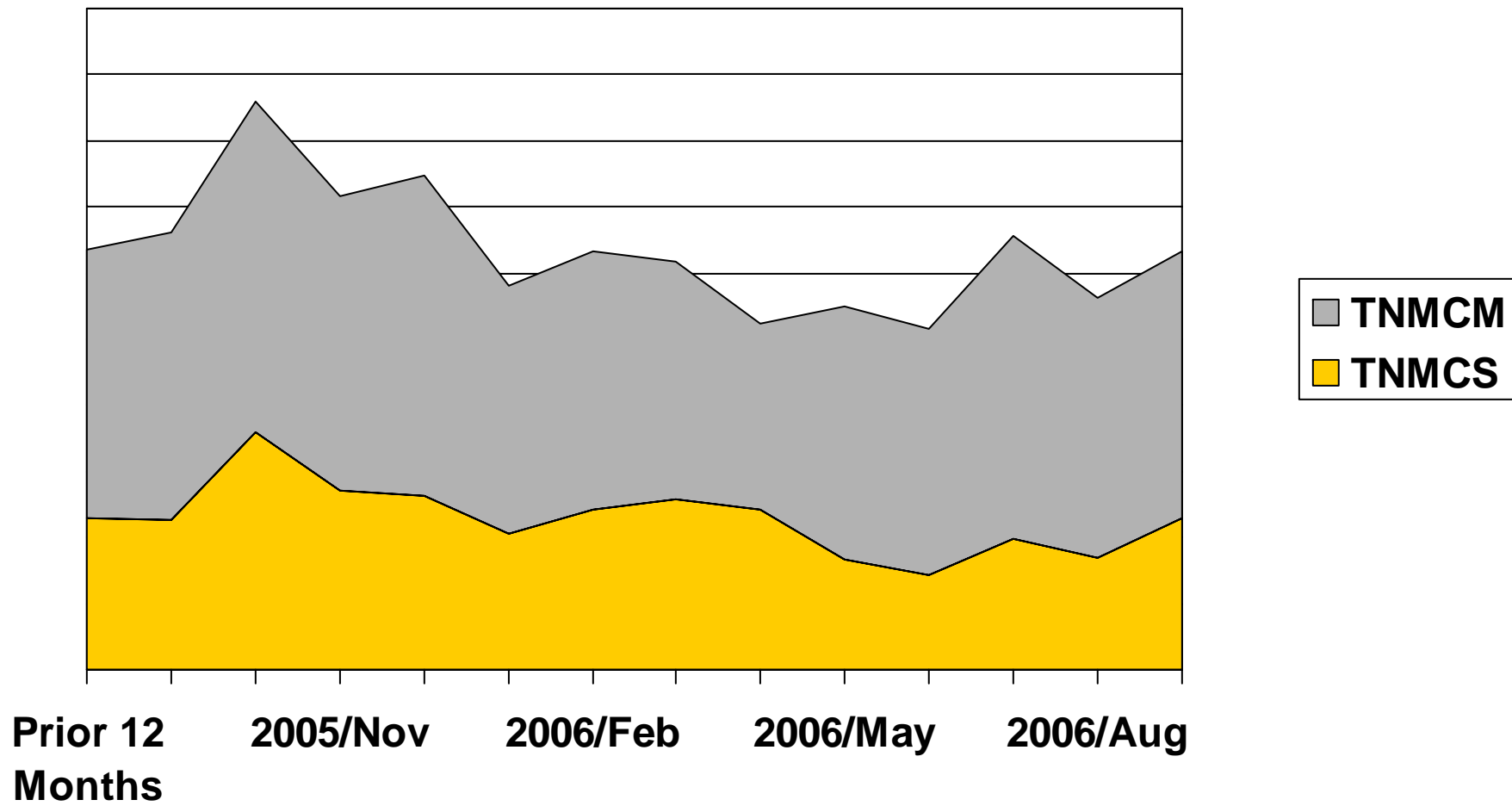




Aircraft 4



Warner Robins Air Logistics Center/EN

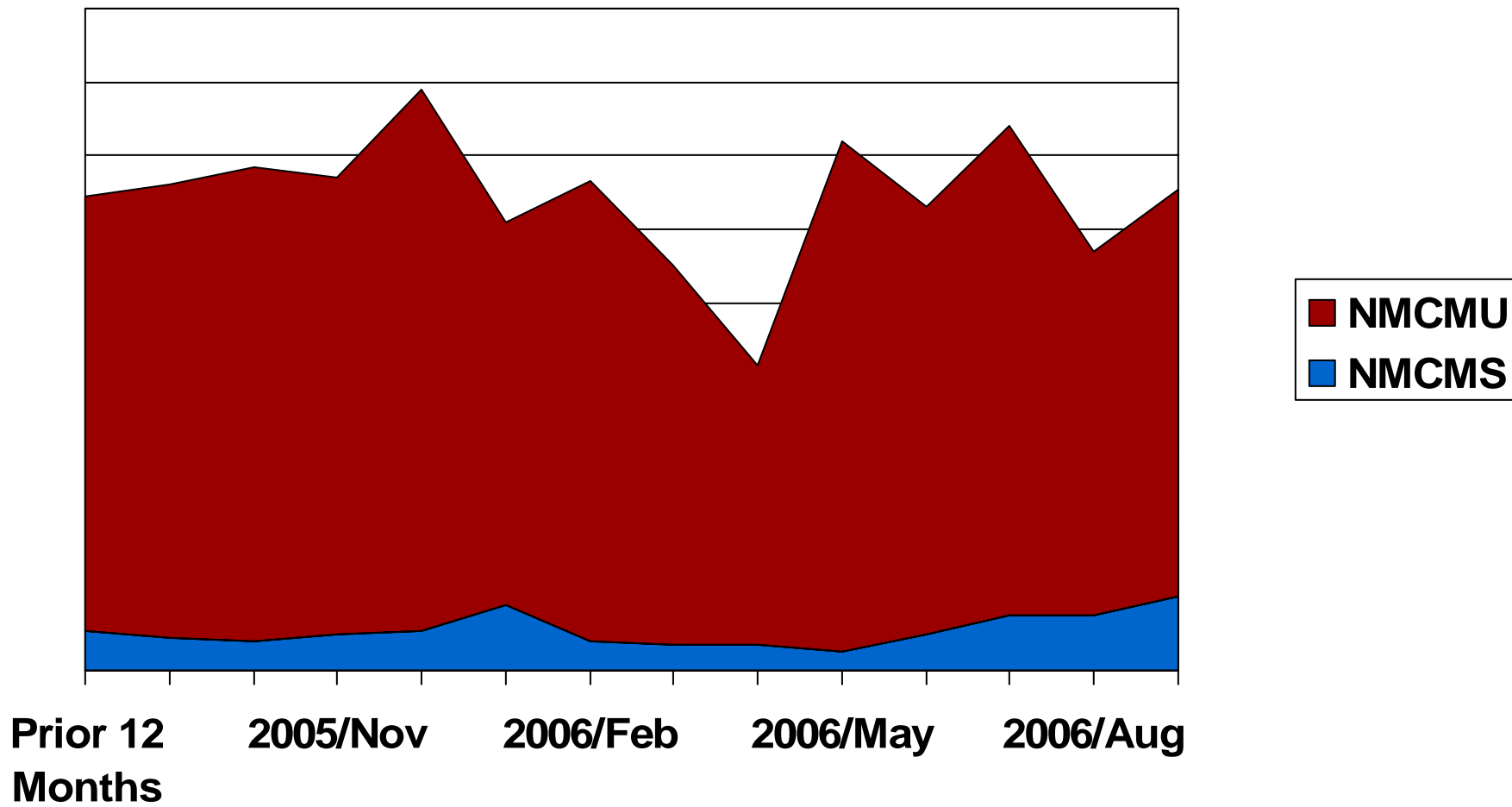




Aircraft 4



Warner Robins Air Logistics Center/EN

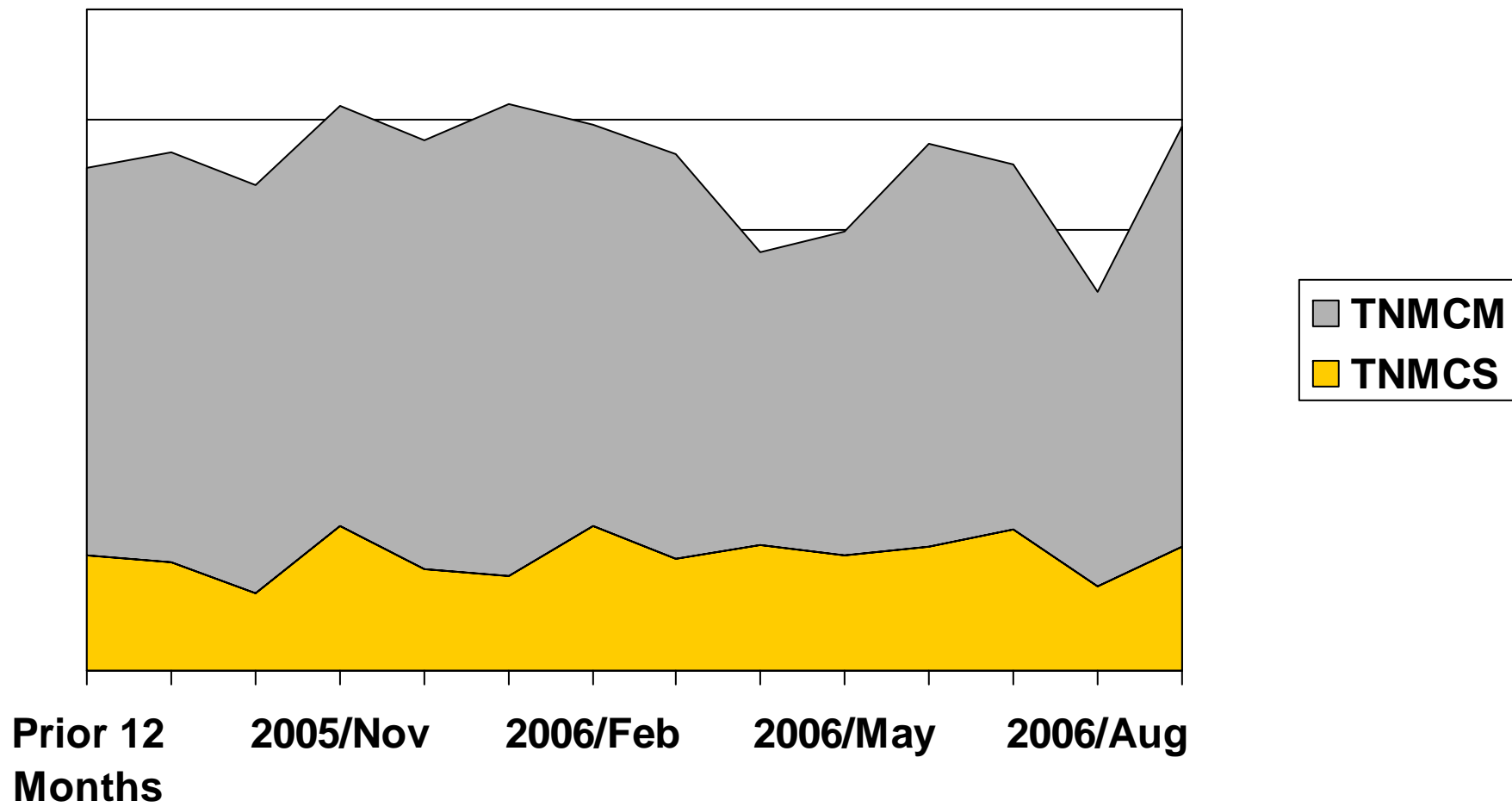




Aircraft 5



Warner Robins Air Logistics Center/EN

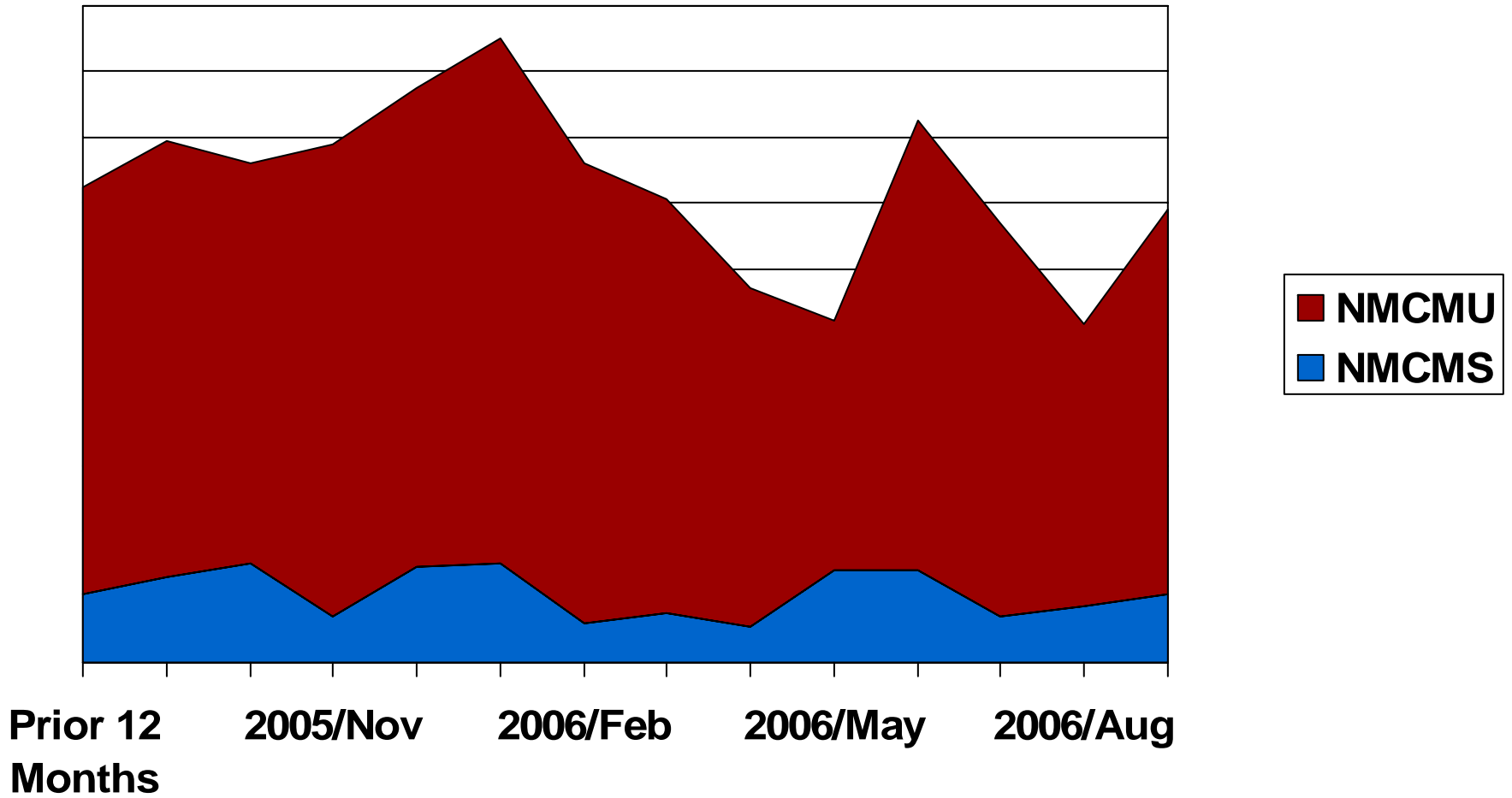




Aircraft 5



Warner Robins Air Logistics Center/EN

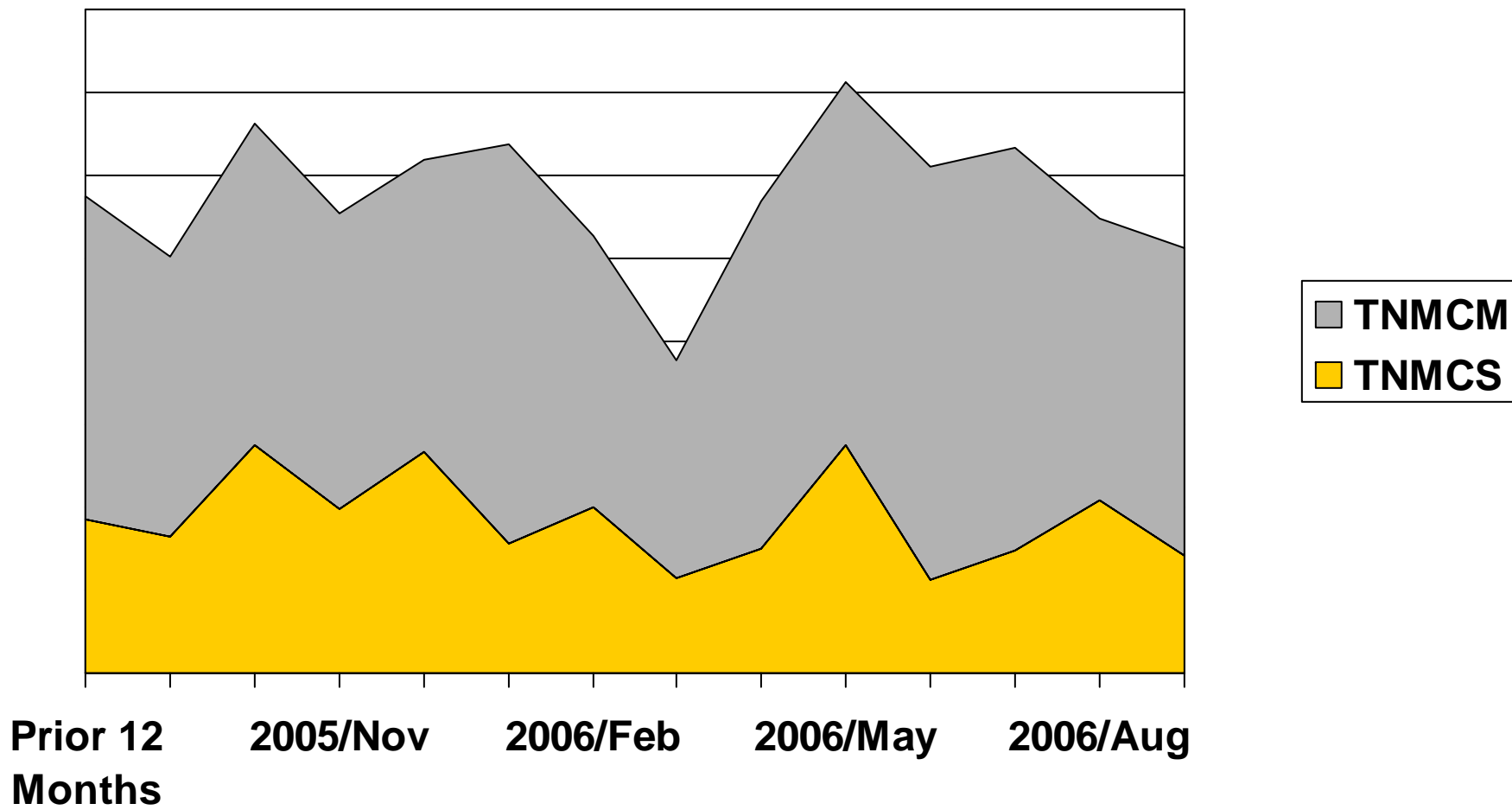




Aircraft 6



Warner Robins Air Logistics Center/EN

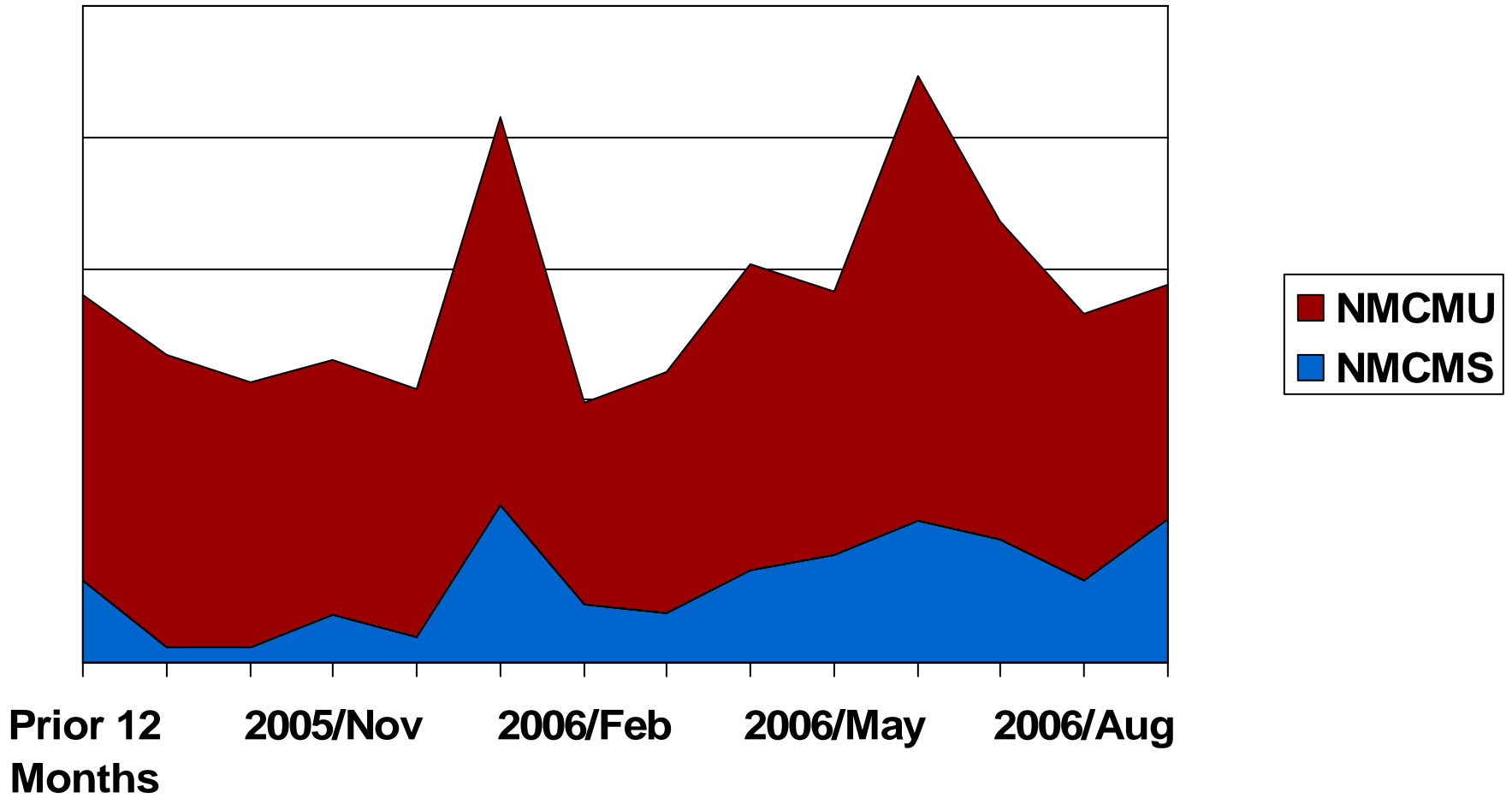




Aircraft 6



Warner Robins Air Logistics Center/EN

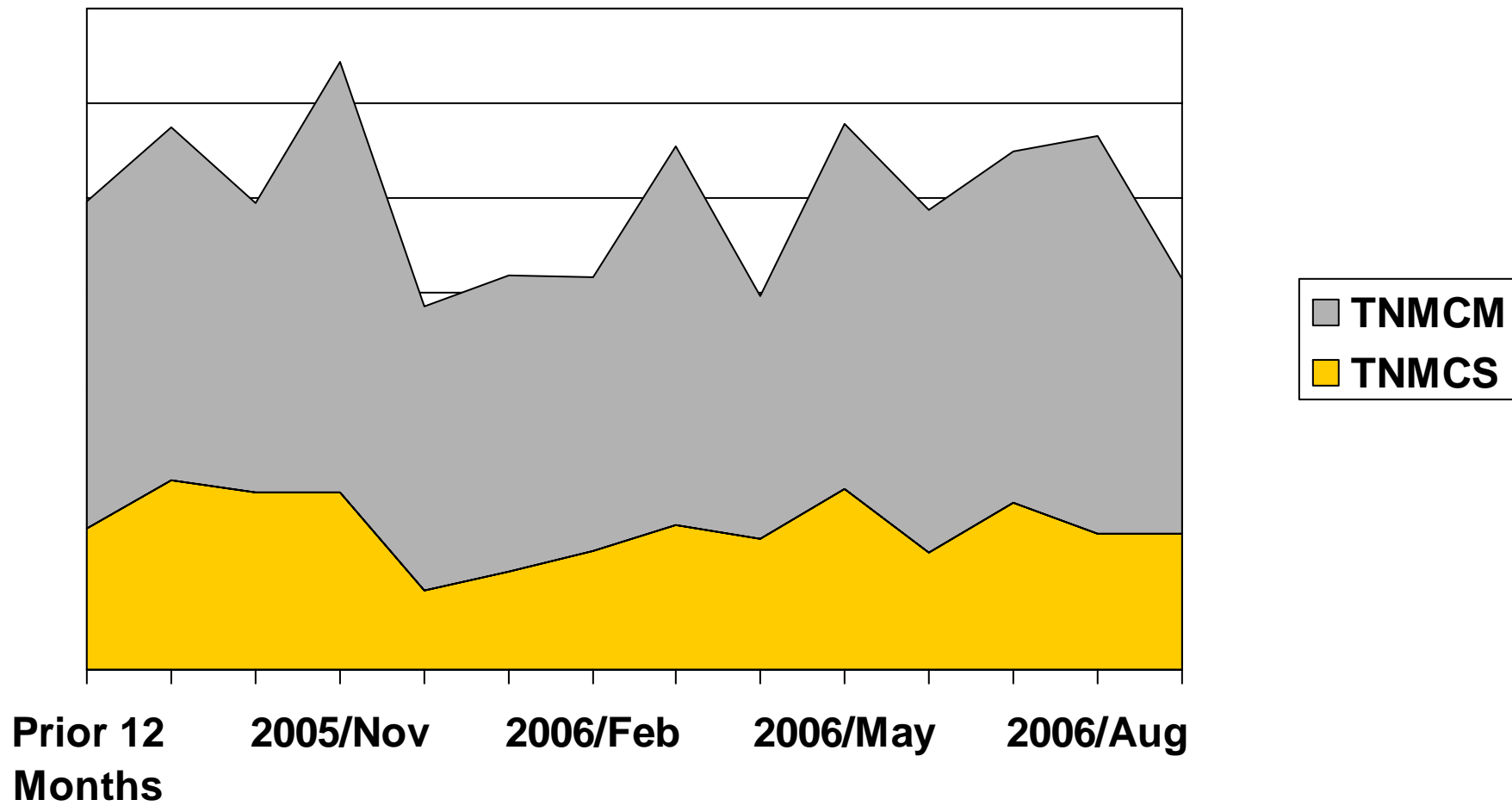




Aircraft 7



Warner Robins Air Logistics Center/EN

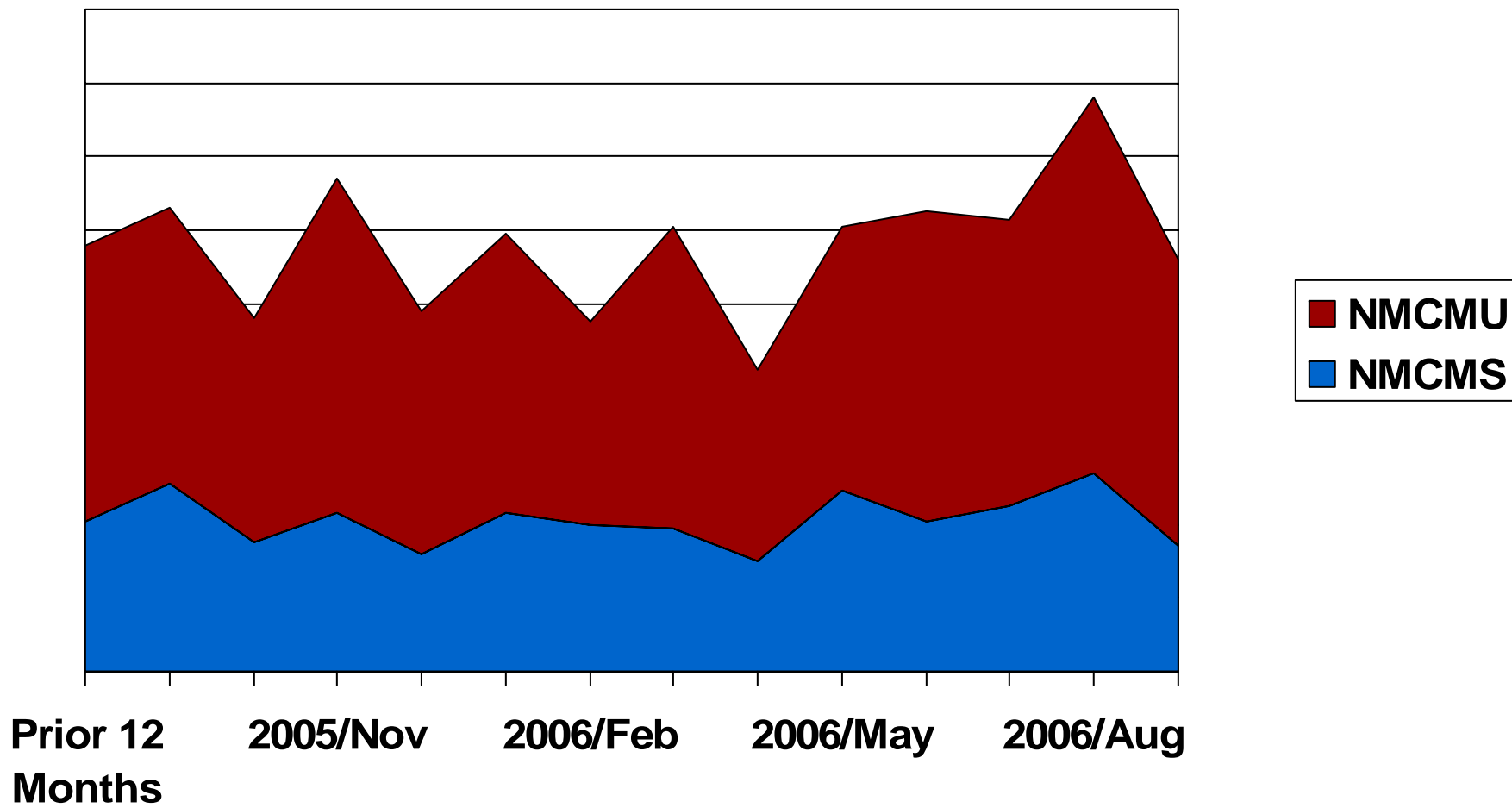




Aircraft 7



Warner Robins Air Logistics Center/EN

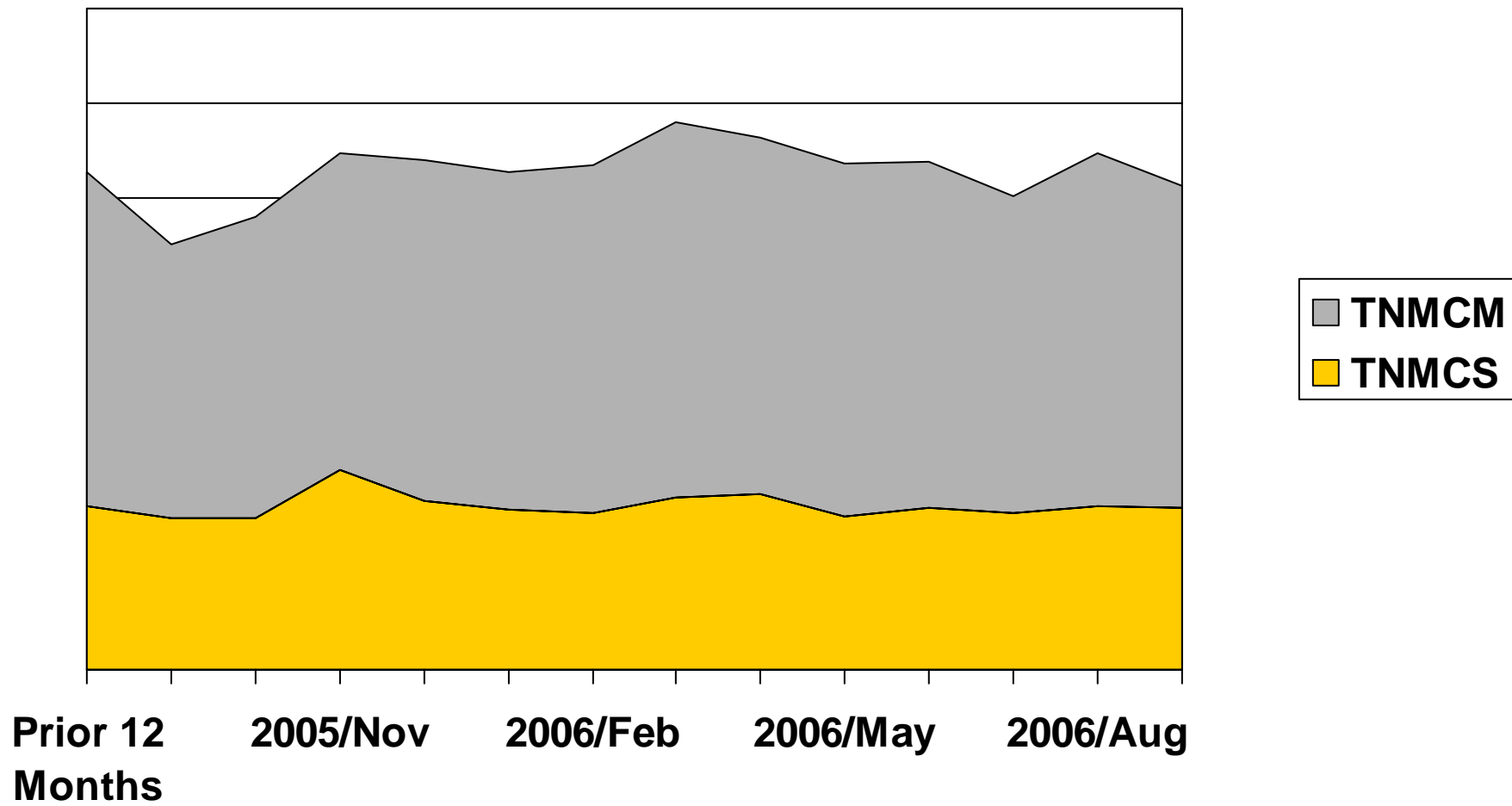




Aircraft 8



Warner Robins Air Logistics Center/EN

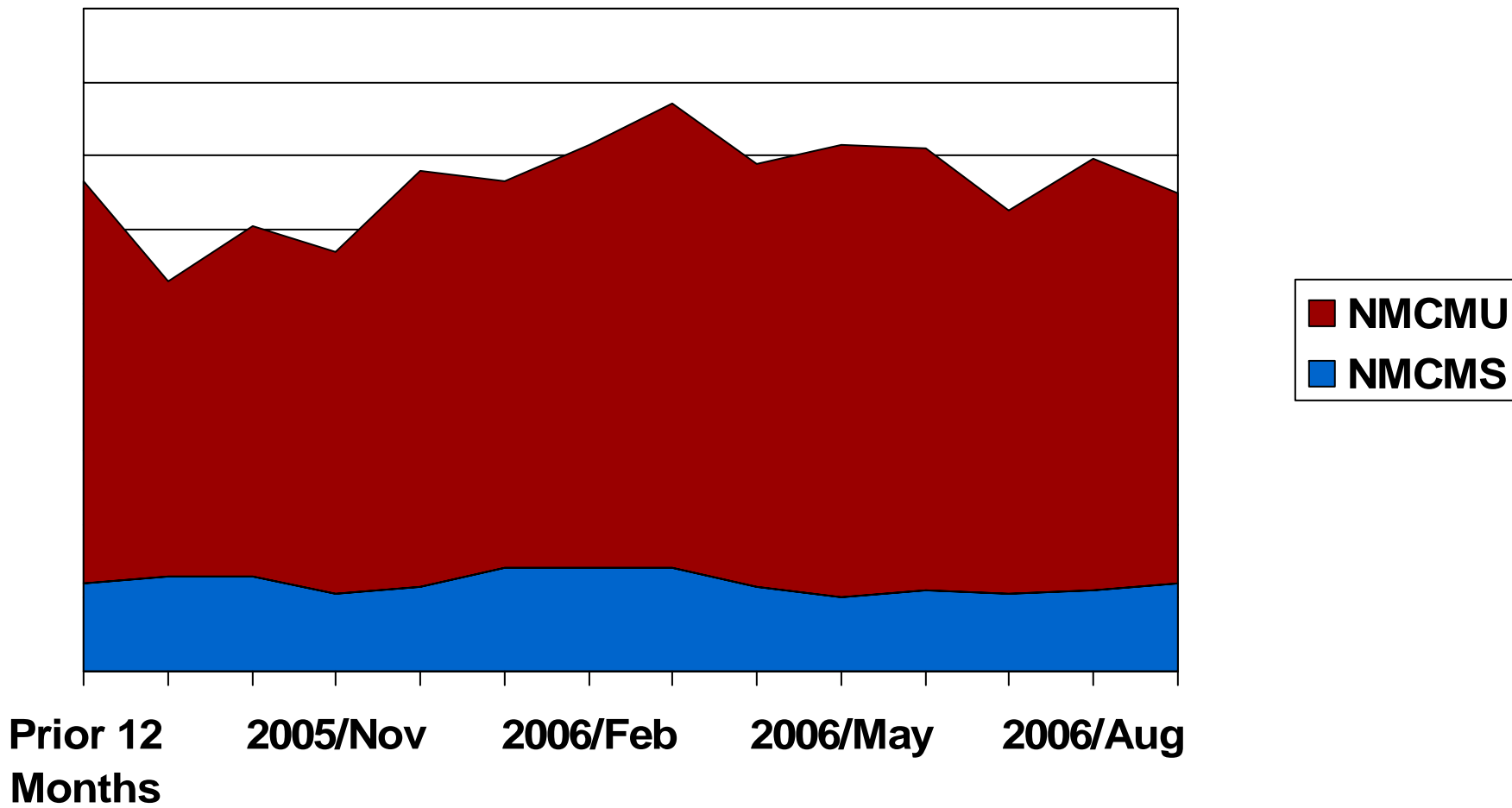




Aircraft 8



Warner Robins Air Logistics Center/EN

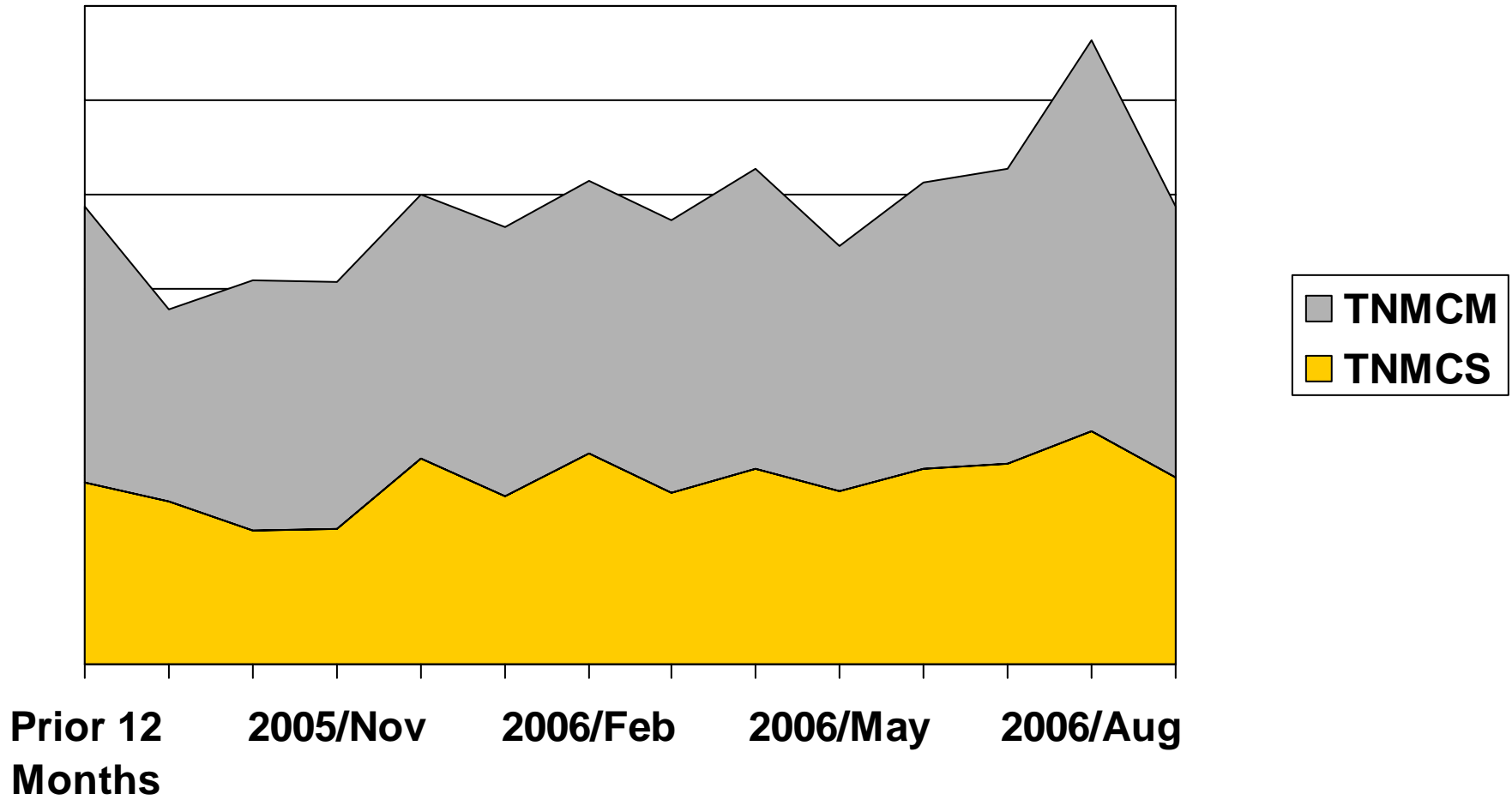




Aircraft 9



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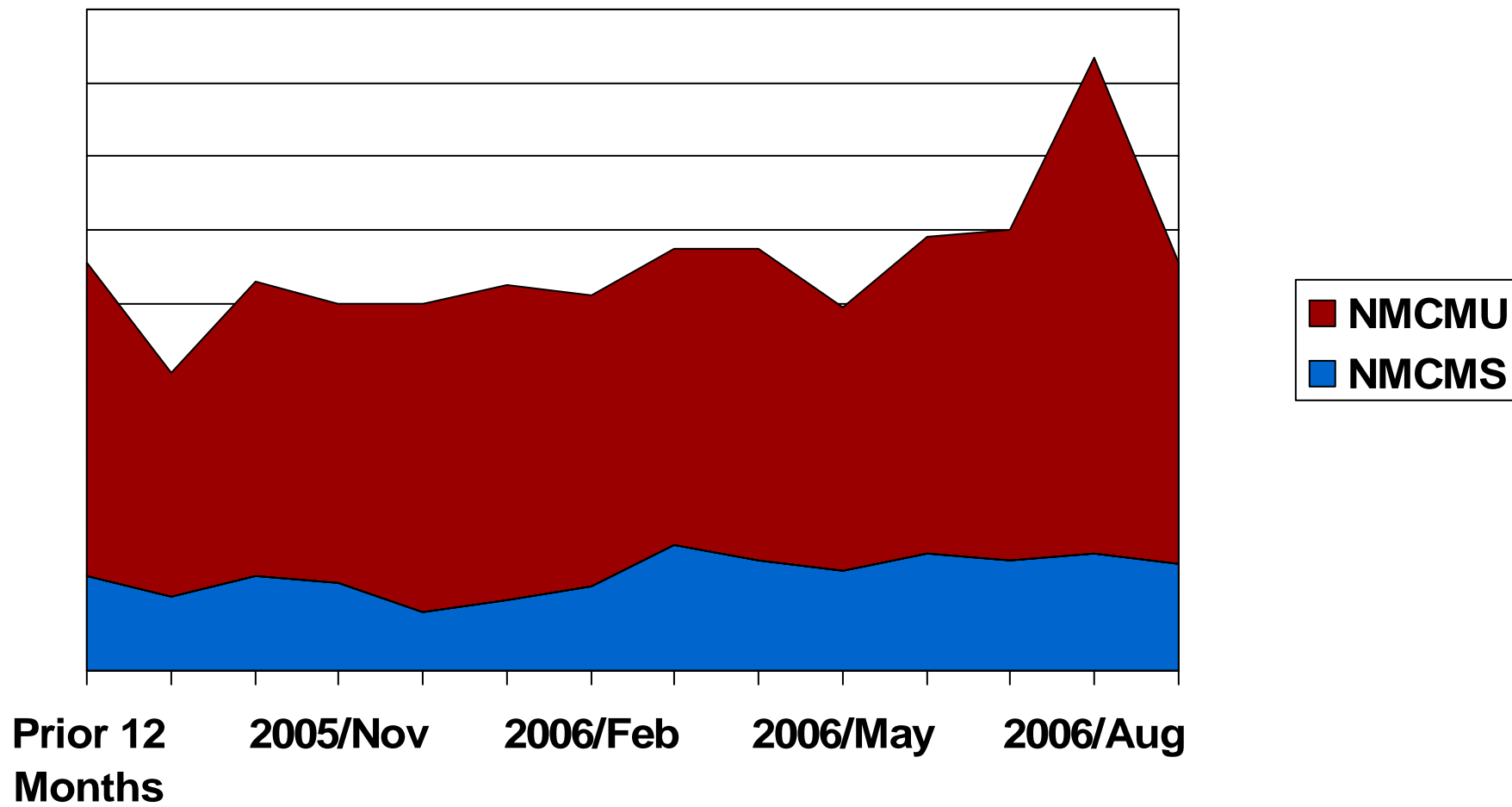




Aircraft 9



Warner Robins Air Logistics Center/EN

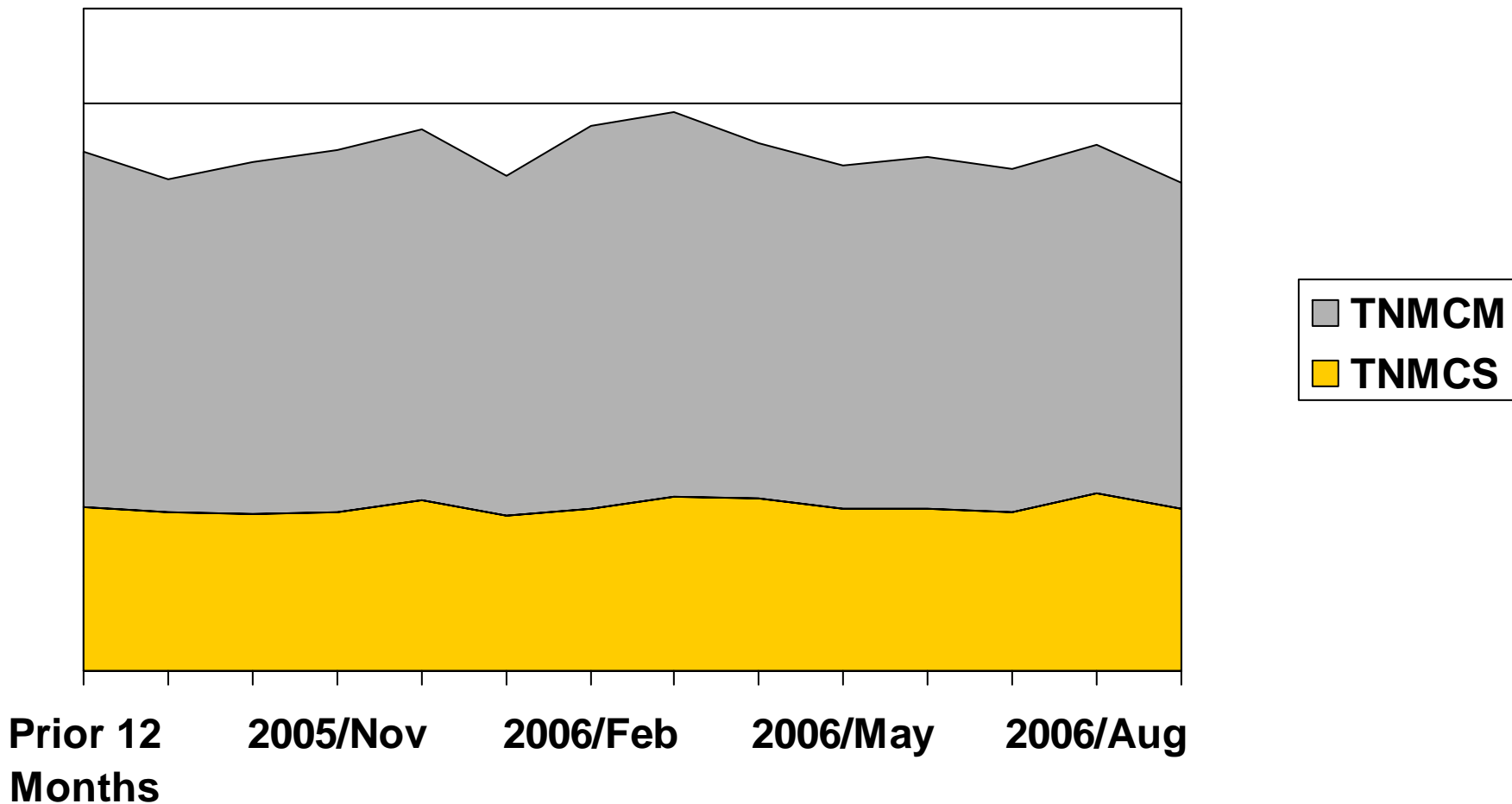




Aircraft 10



Warner Robins Air Logistics Center/EN

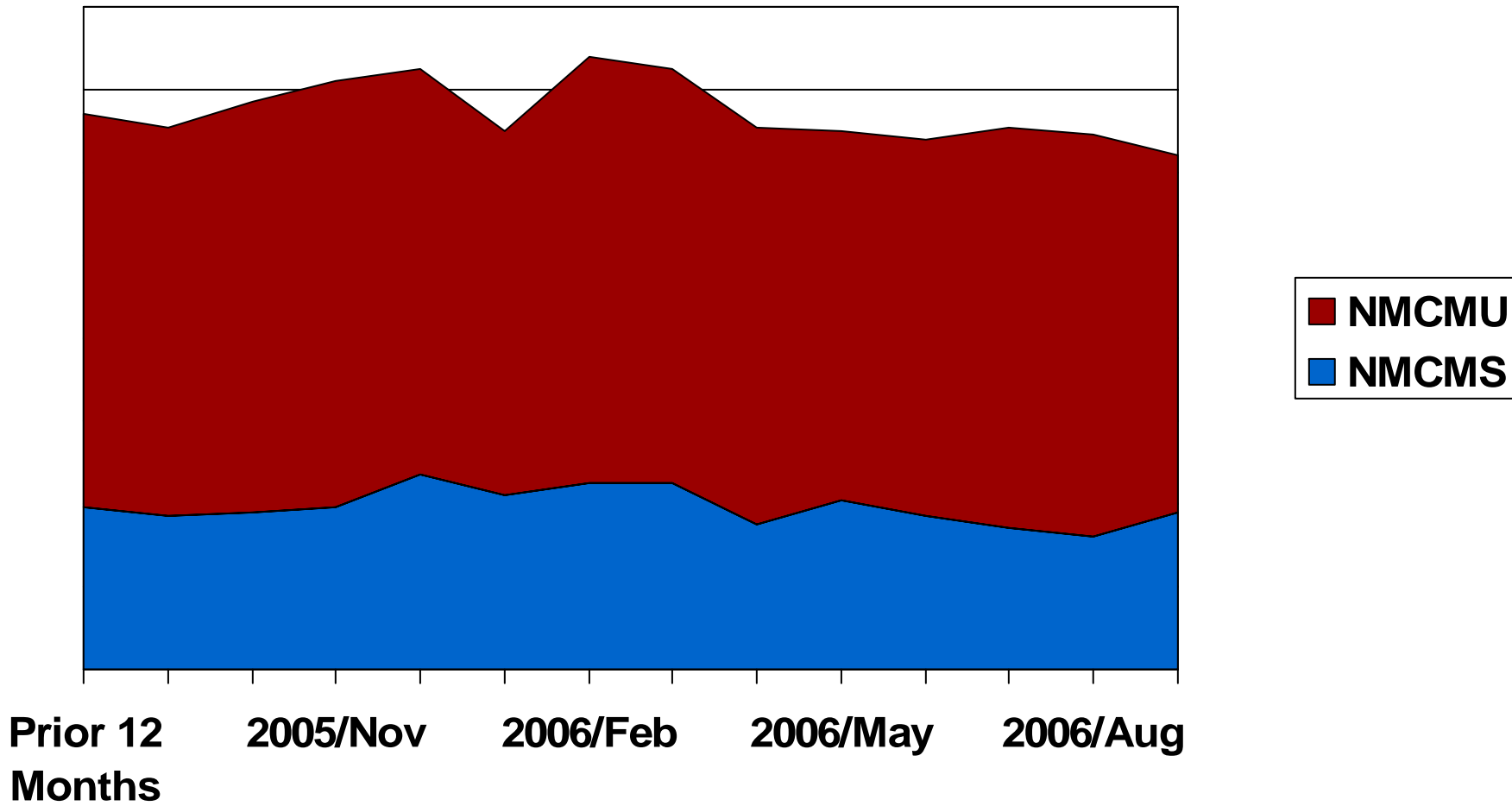




Aircraft 10



Warner Robins Air Logistics Center/EN

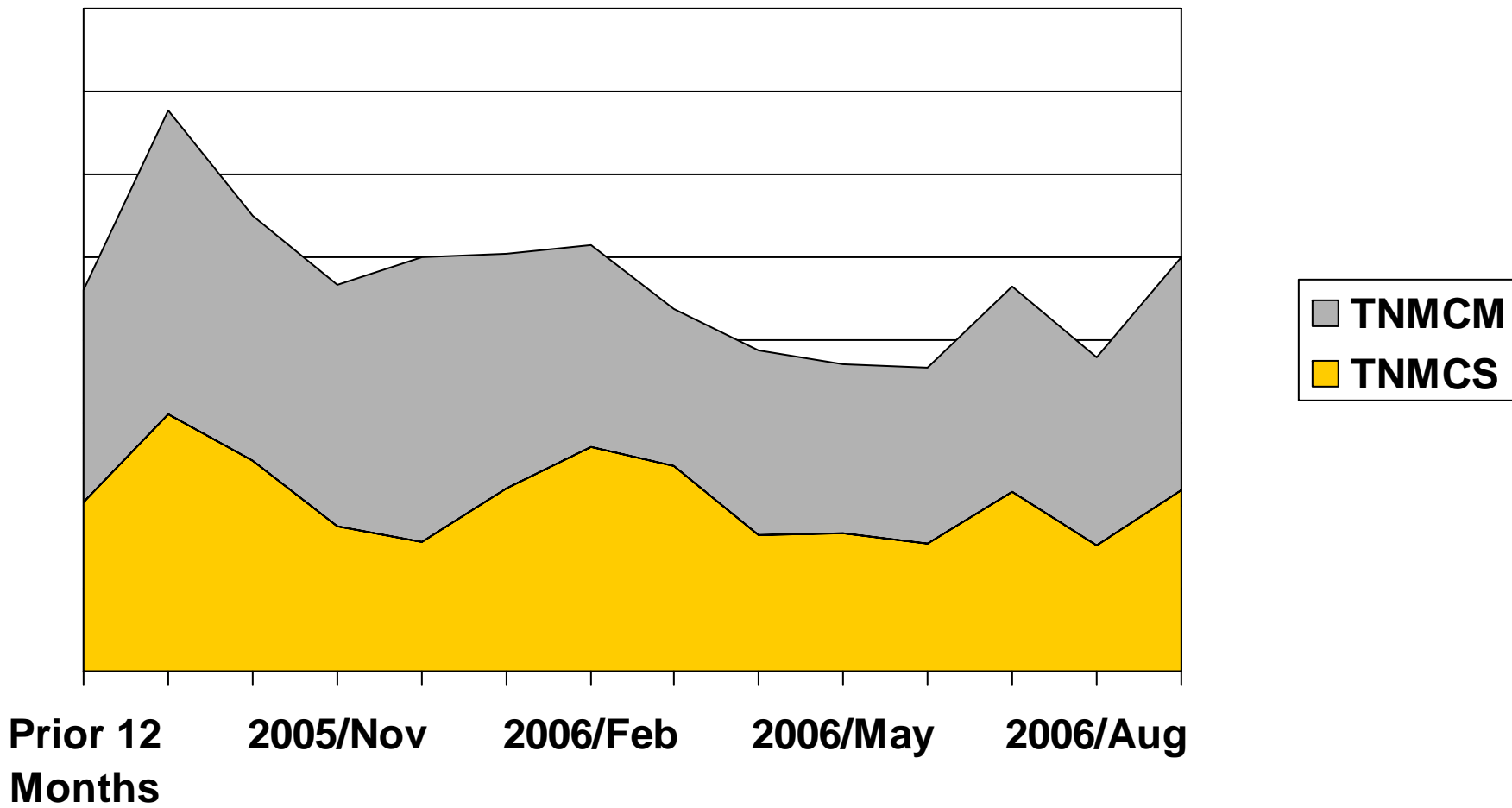




Aircraft 11



Warner Robins Air Logistics Center/EN

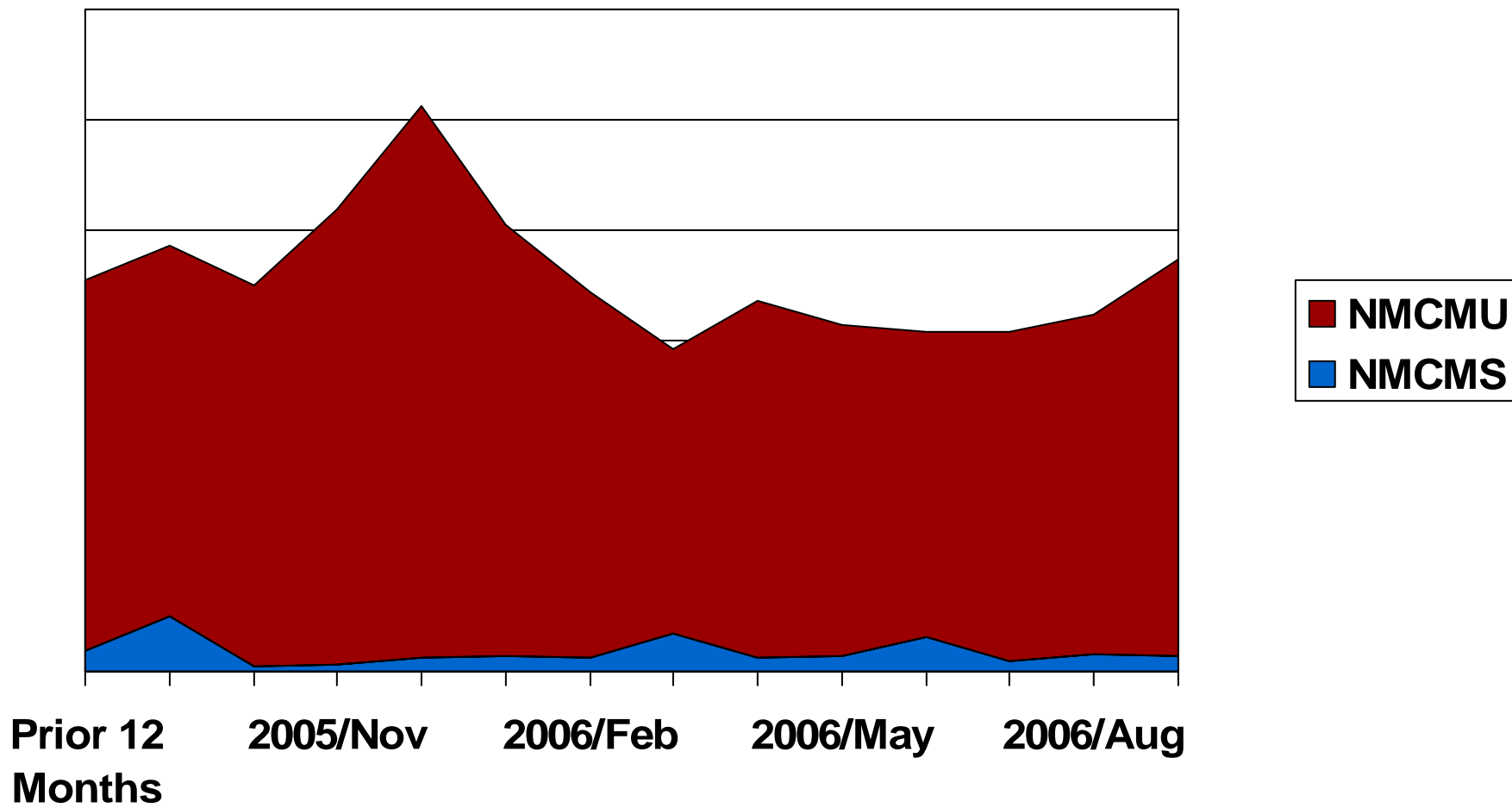




Aircraft 11



Warner Robins Air Logistics Center/EN

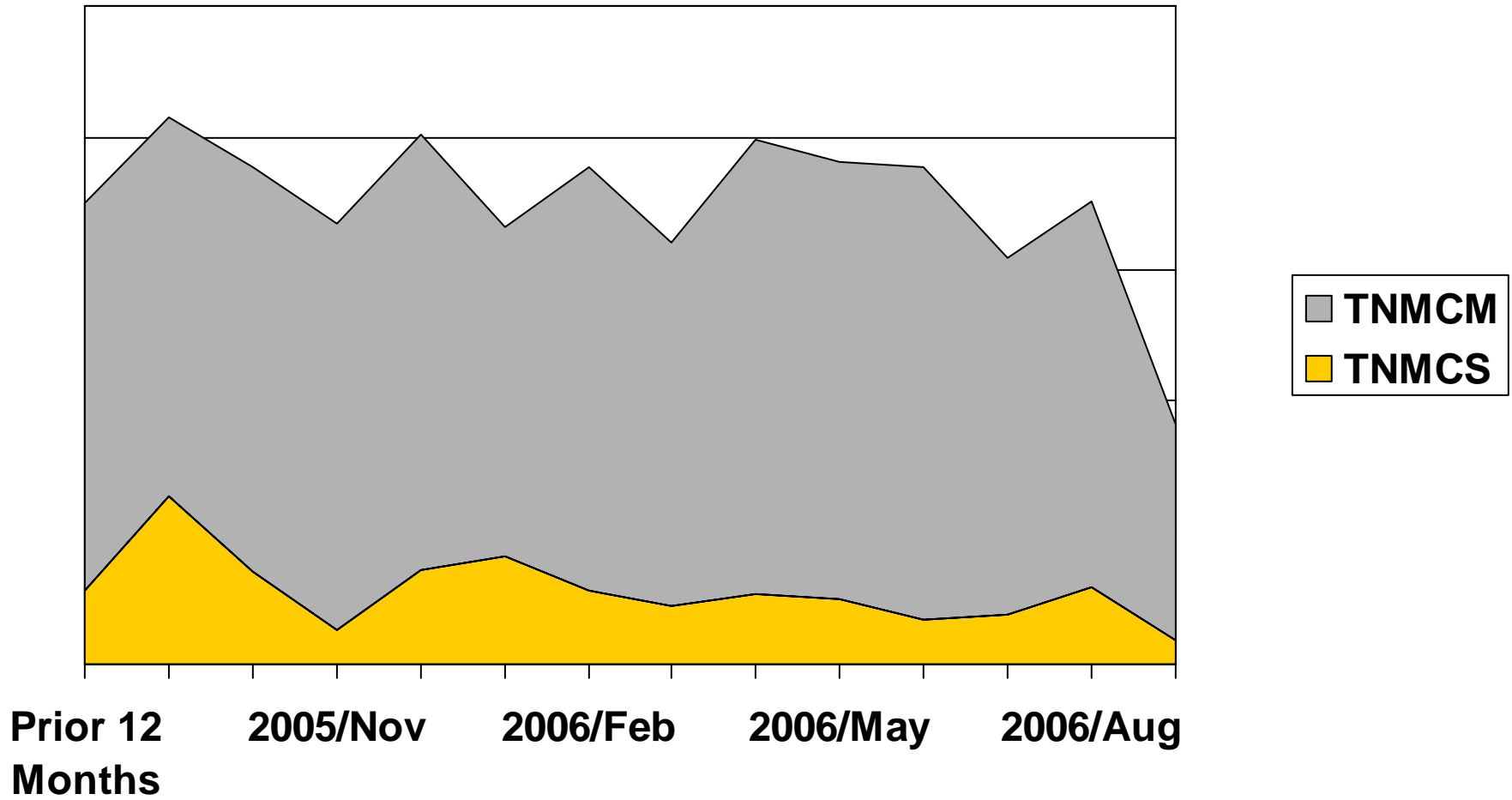




Aircraft 12



Warner Robins Air Logistics Center/EN

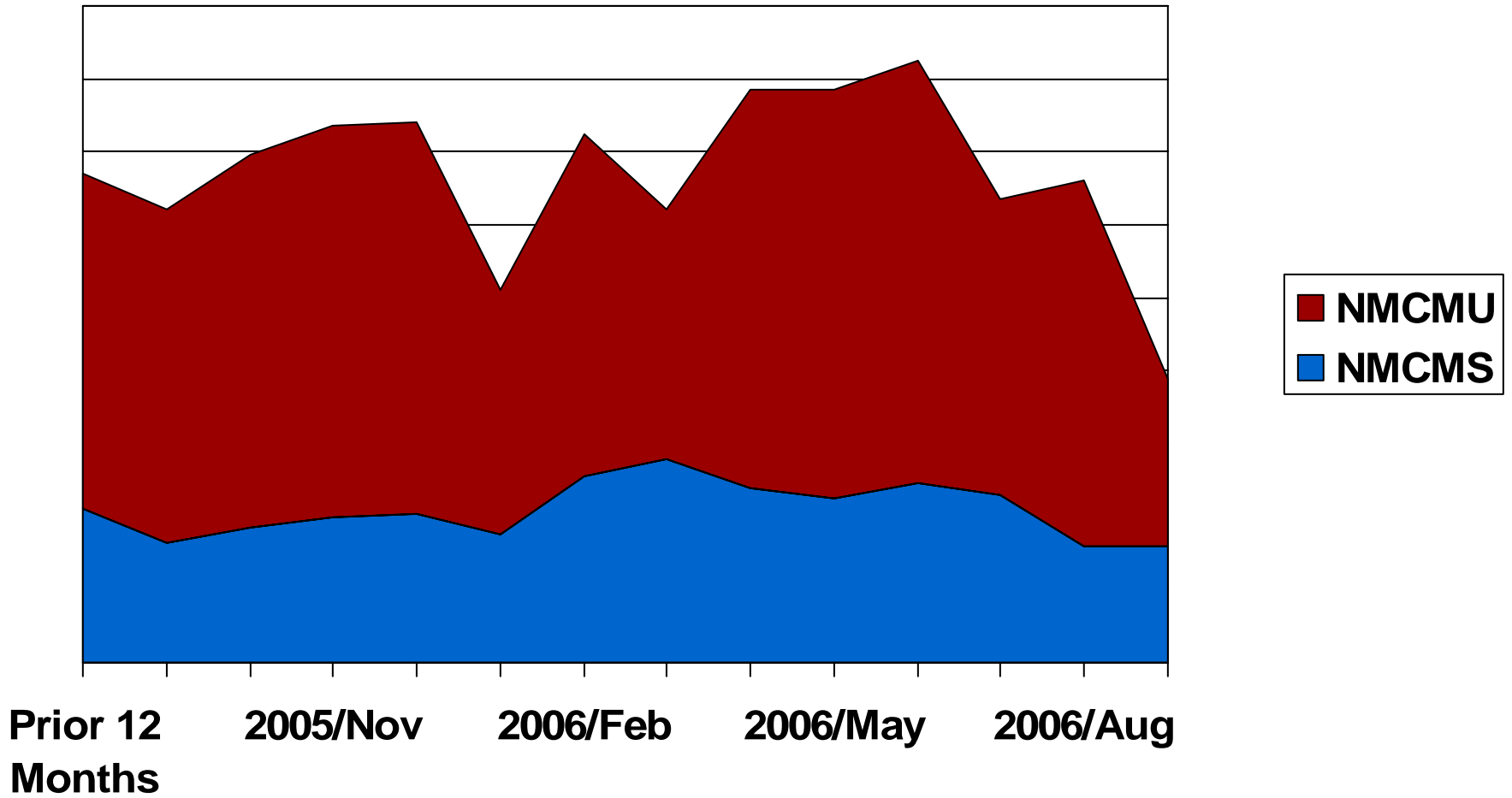




Aircraft 12



Warner Robins Air Logistics Center/EN

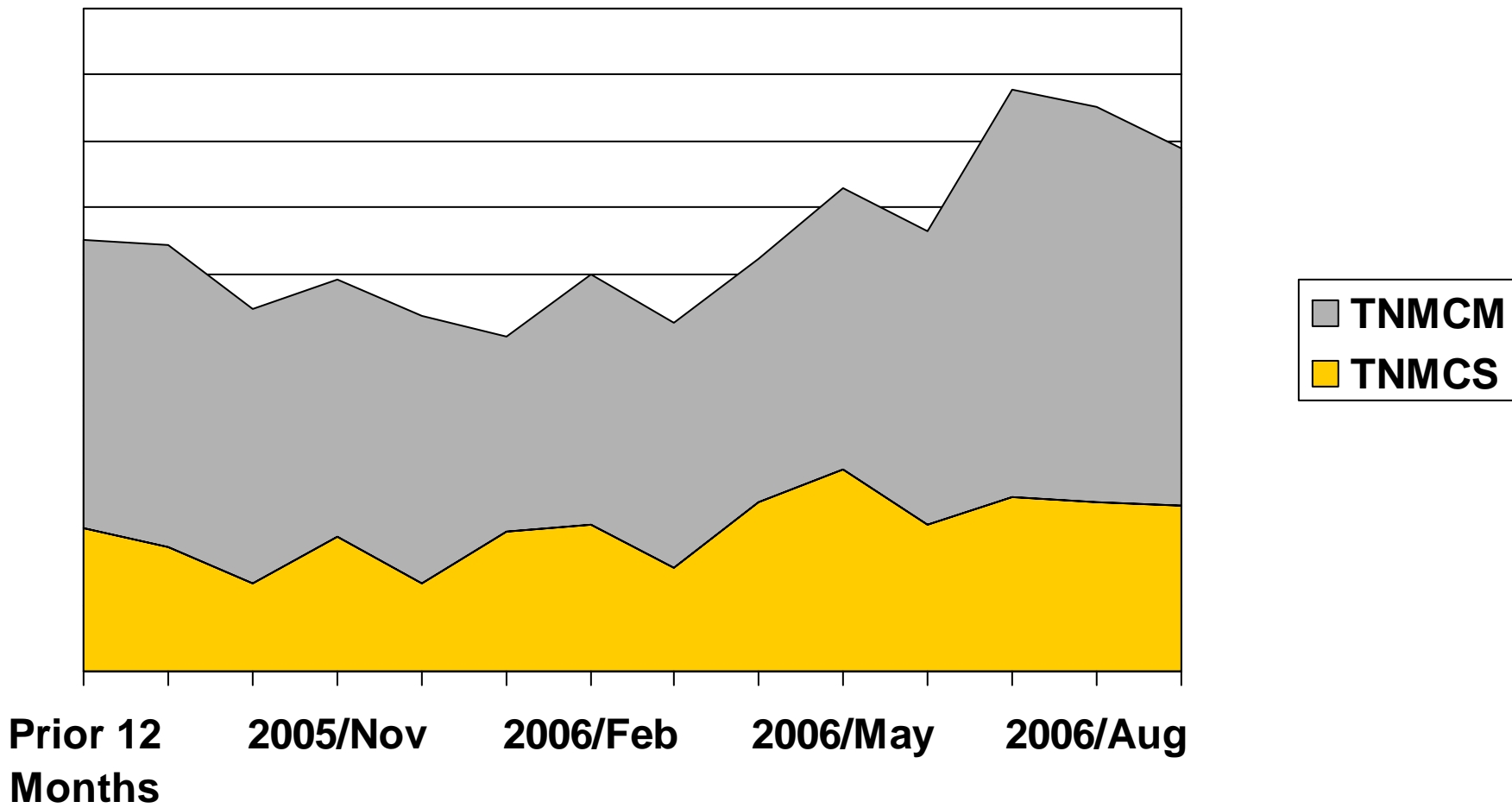




Aircraft 13



Warner Robins Air Logistics Center/EN

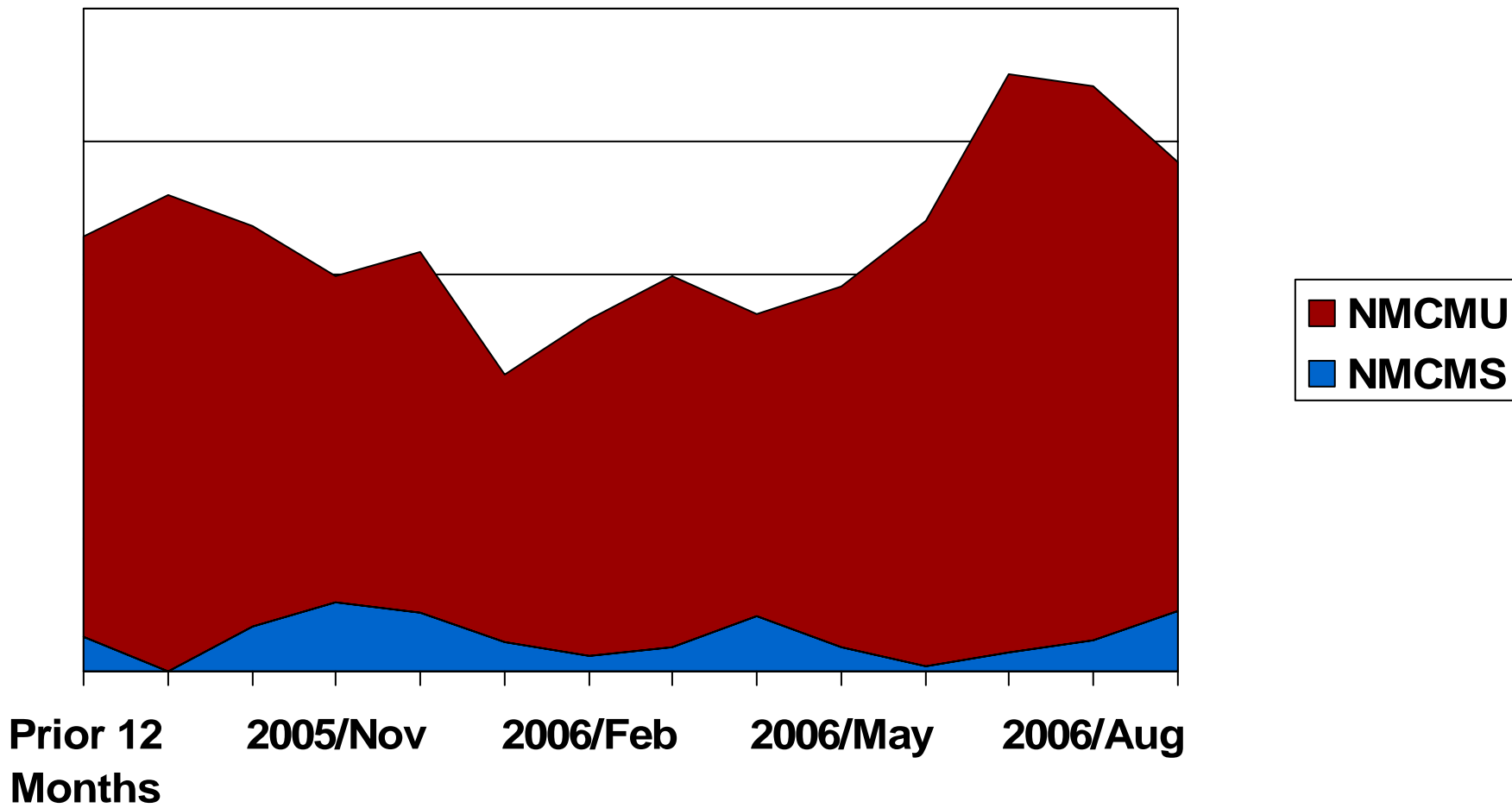




Aircraft 13



Warner Robins Air Logistics Center/EN

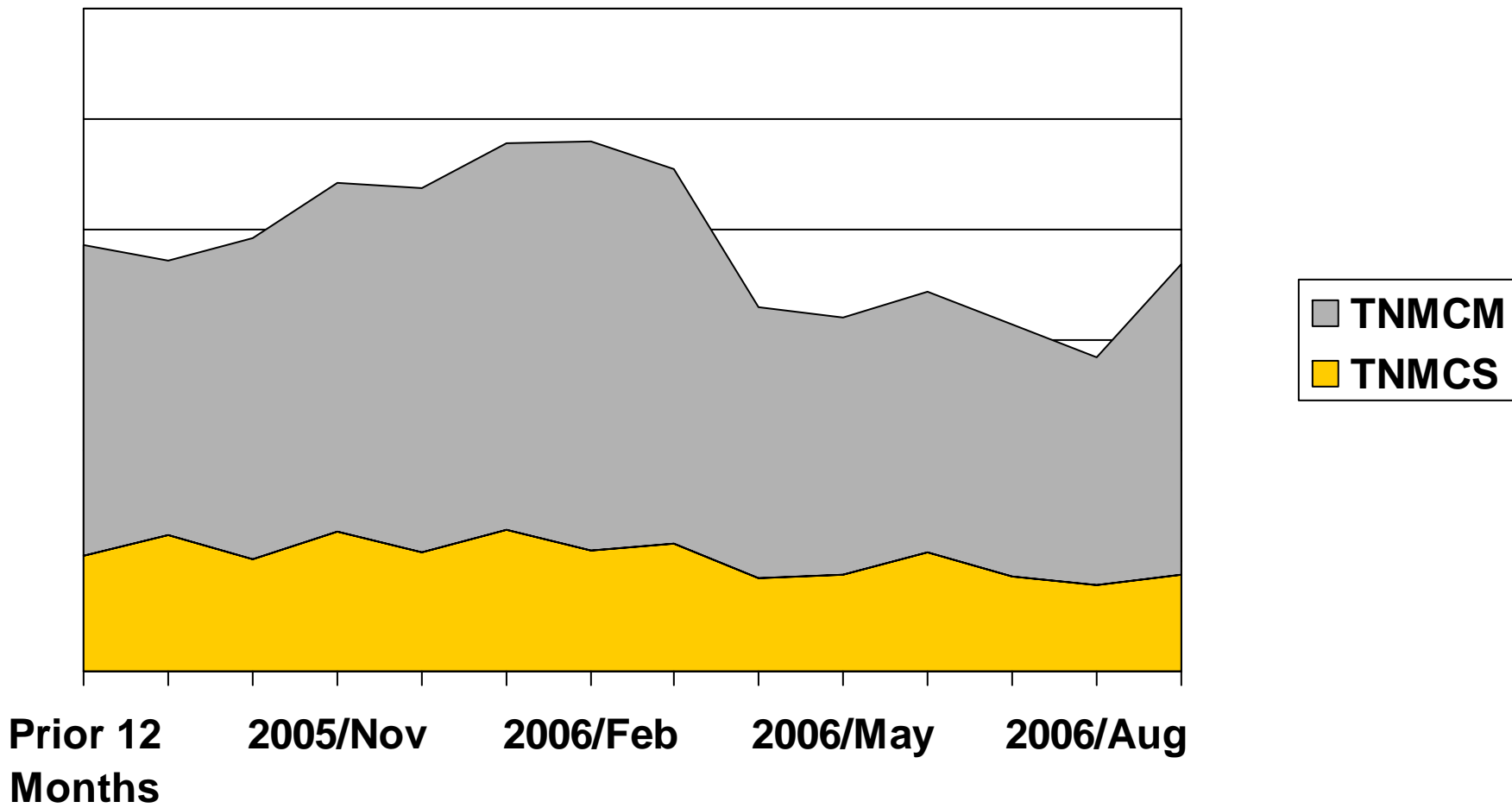




Aircraft 14



Warner Robins Air Logistics Center/EN

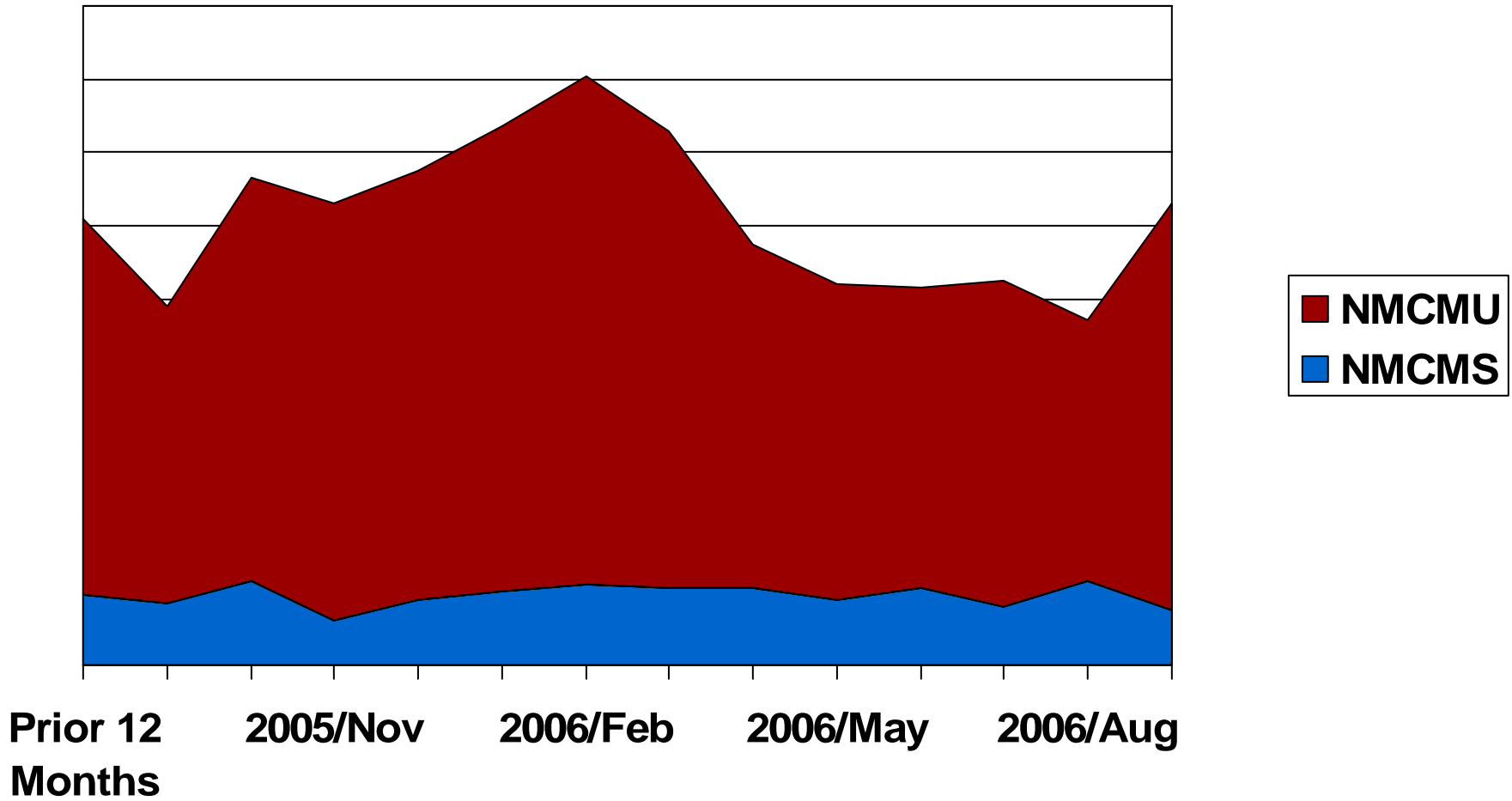




Aircraft 14



Warner Robins Air Logistics Center/EN

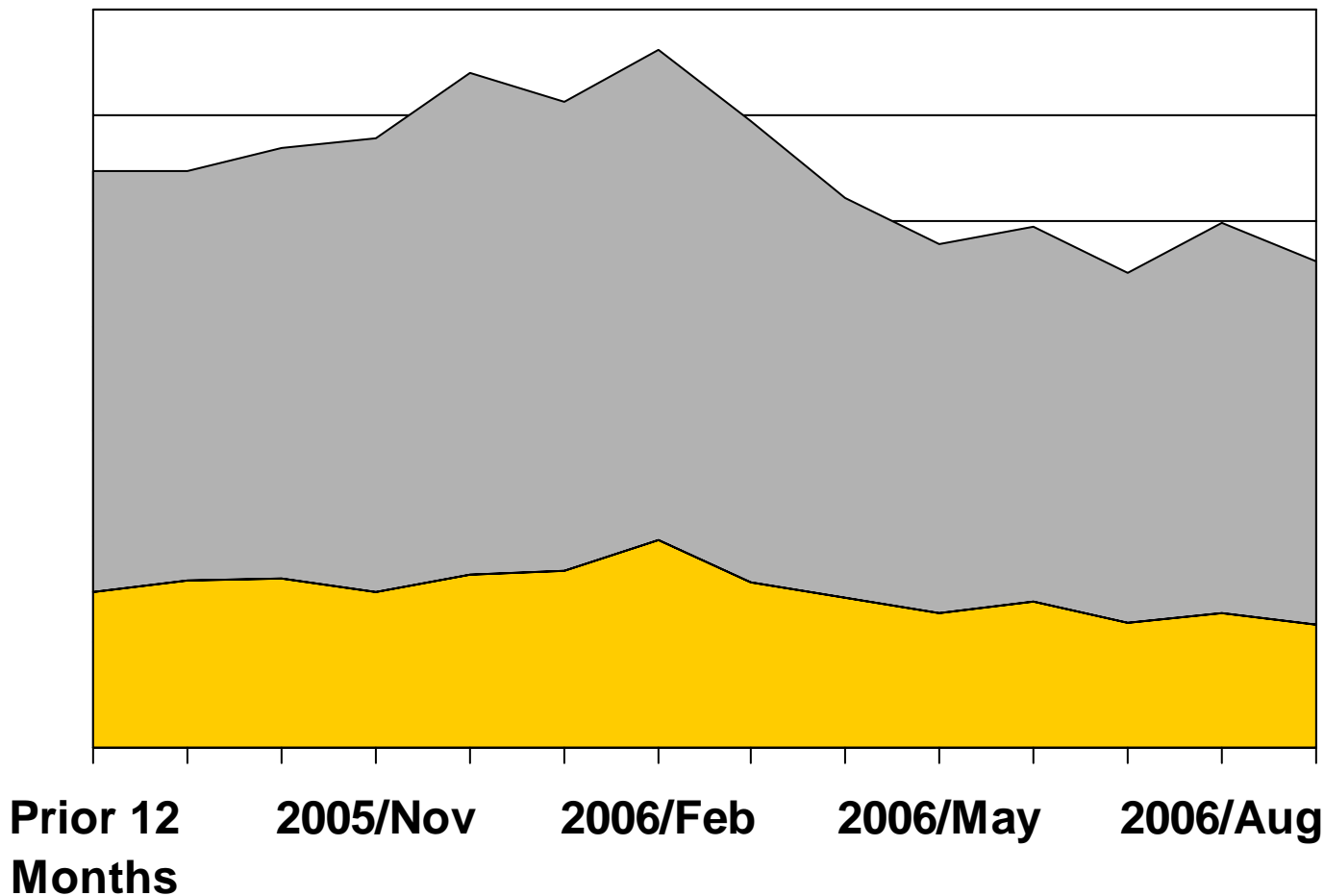




Aircraft 15



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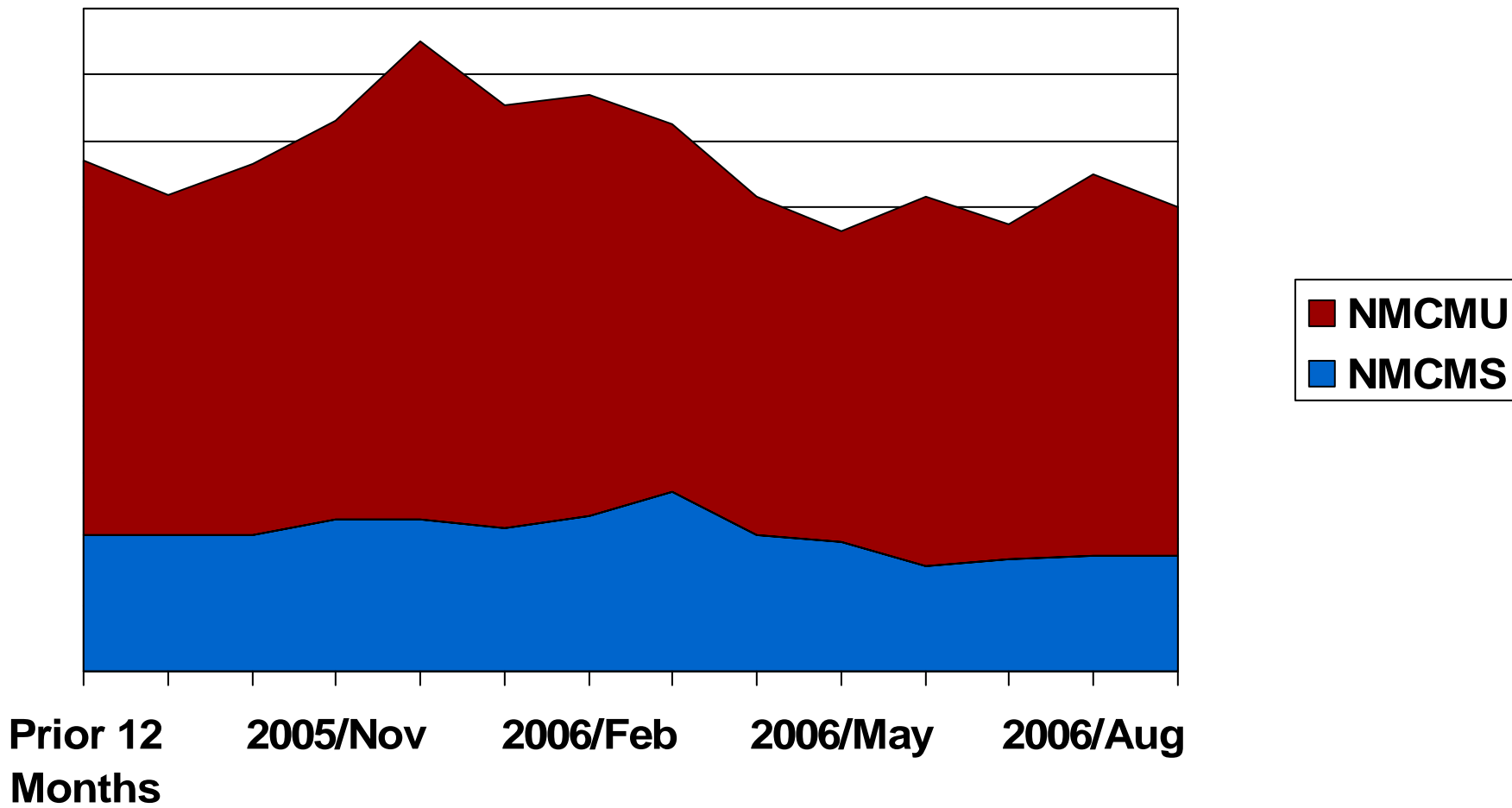




Aircraft 15



Warner Robins Air Logistics Center/EN

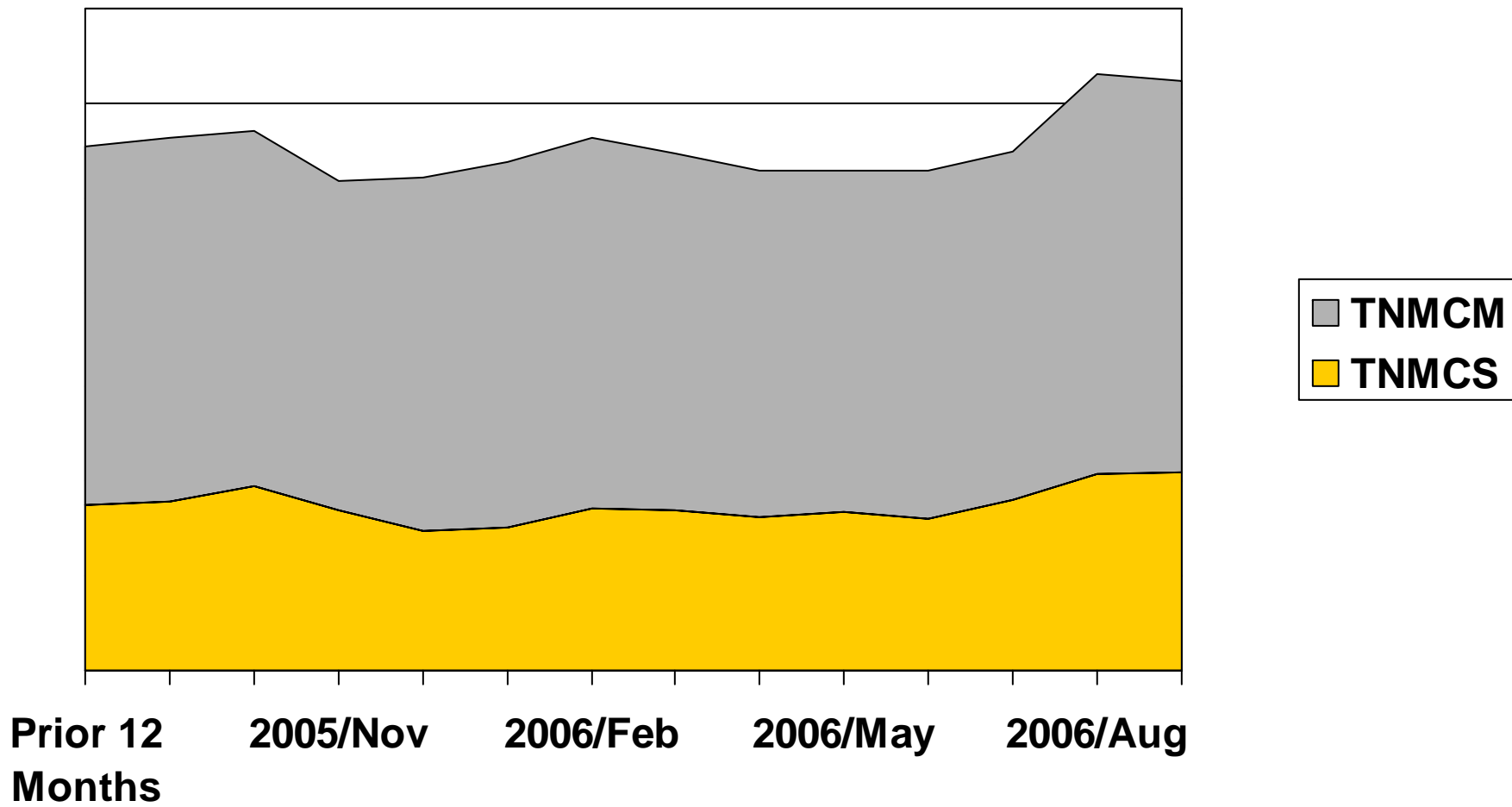




Aircraft 16



Warner Robins Air Logistics Center/EN

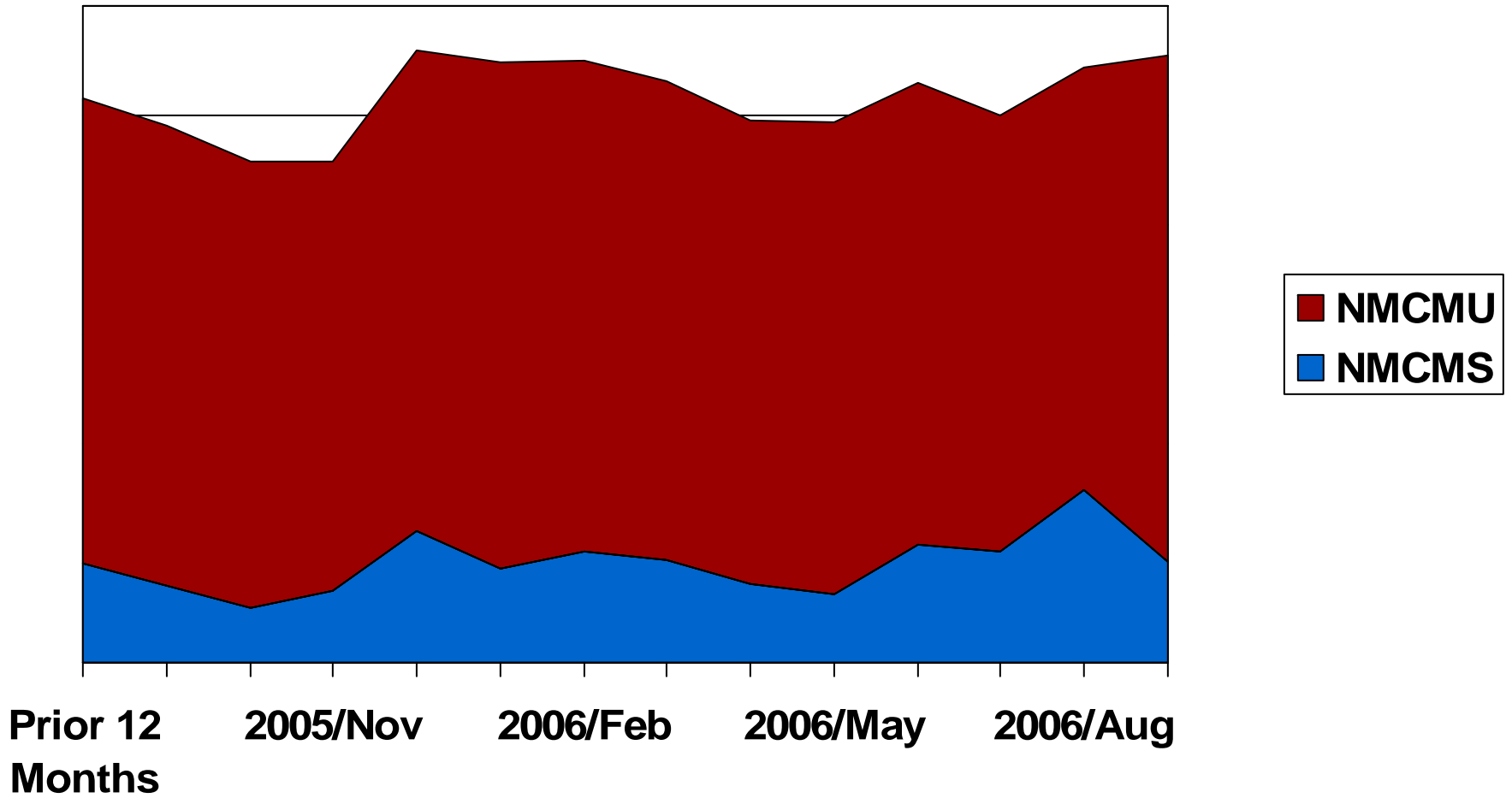




Aircraft 16



Warner Robins Air Logistics Center/EN

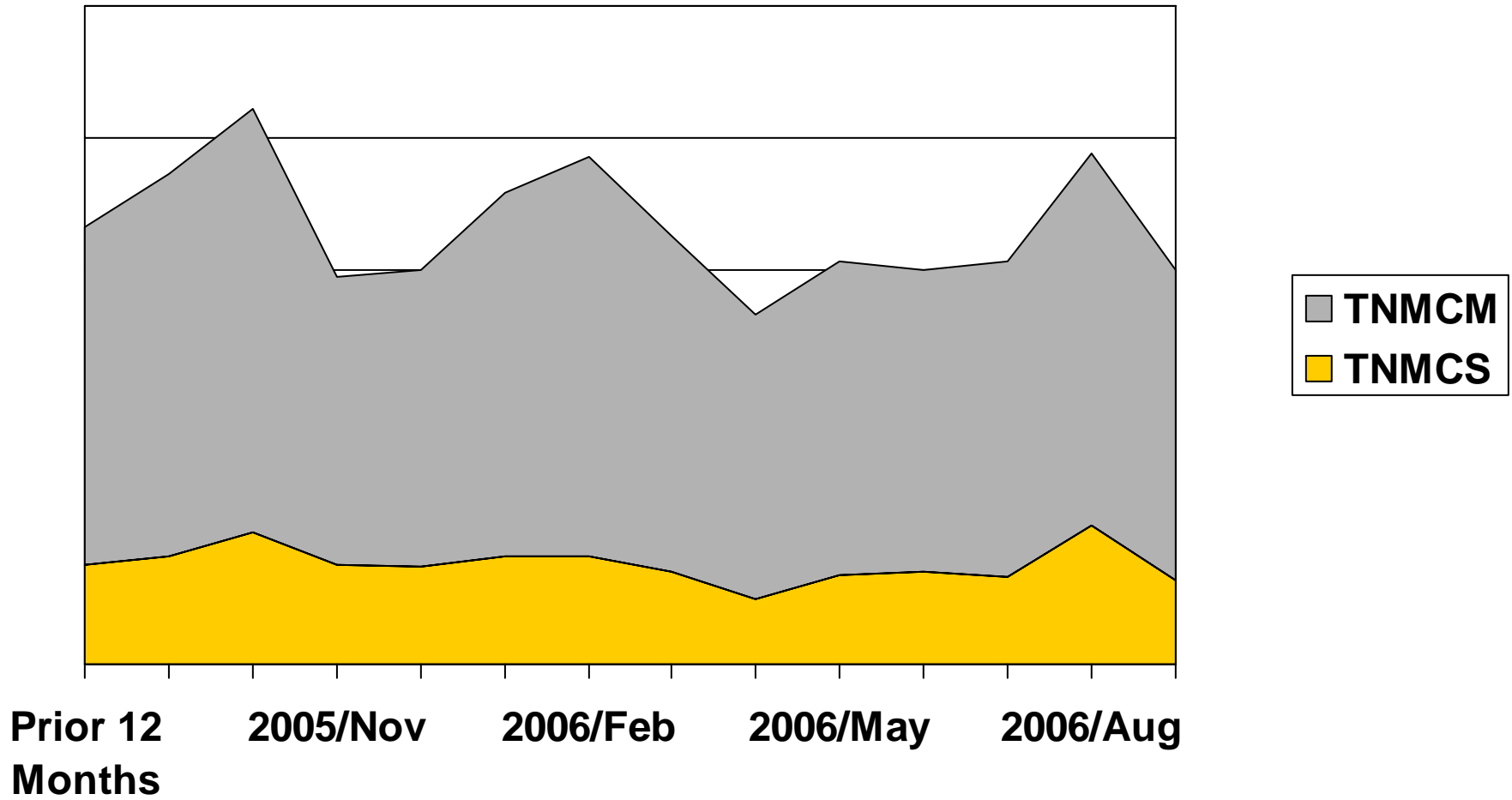




Aircraft 17



Warner Robins Air Logistics Center/EN

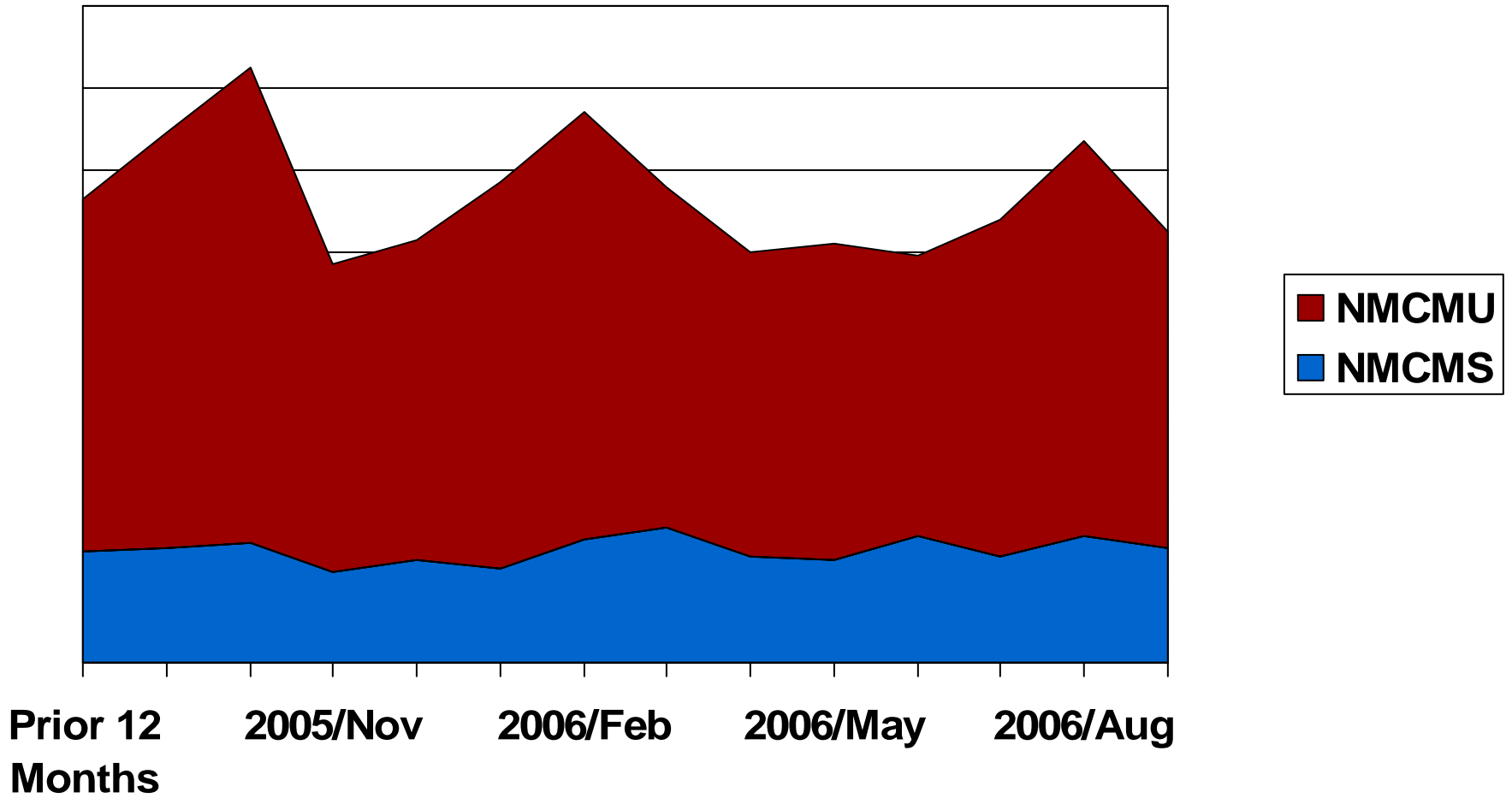




Aircraft 17



Warner Robins Air Logistics Center/EN

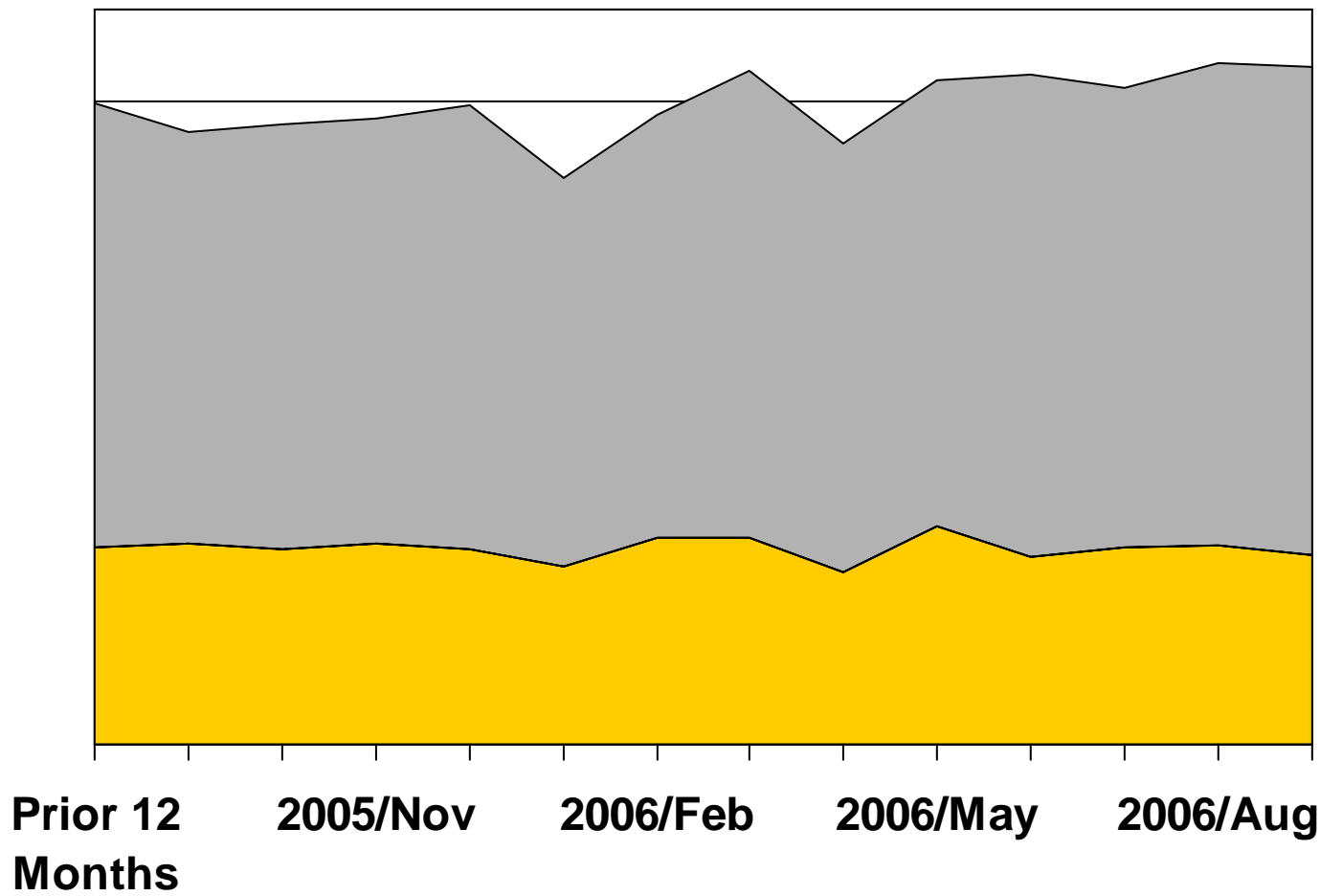




Aircraft 18



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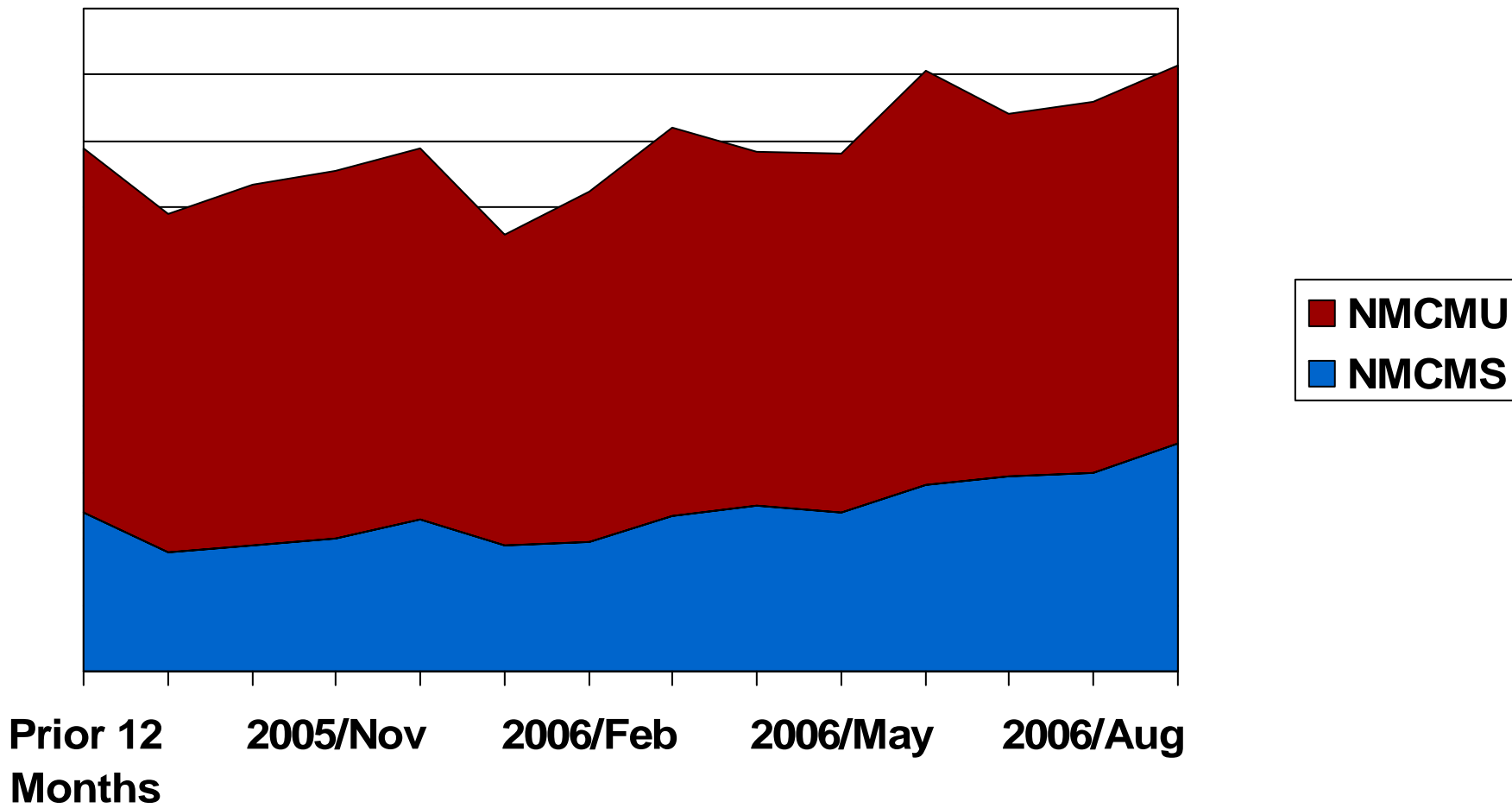




Aircraft 18



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Observations

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- Notice the relative contributions to downtime from **supply** and **maintenance**, and the contributions of **scheduled** and **unscheduled** maintenance.
 - In every case, **maintenance** contributes more to downtime than **supply**
 - In every case, **unscheduled maintenance** contributes more than **scheduled maintenance**
- We, the Air Force, have made a concerted effort to go after...supply and scheduled maintenance



Data



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- Unscheduled maintenance means that something failed
- Is it important to know when things fail?
- **ABSOLUTELY!**
- In most cases, engineers only find out about things that fail if they're not covered by the TO



Risk Management



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- In order to manage risk, you have to be able to determine risk
- To determine structural risk, you have to know:
 - Crack length
 - Crack growth curve
 - Equivalent Initial Flaw Size (EIFS) distribution – determined from aircraft condition data
 - Loads applied
 - Exceedance curves
 - Residual strength
 - Probability of Detection of NDI
- Without current aircraft condition data, you don't have a chance!



Risk Data



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- Rather than make up data, we issue a “hair on fire” TCTO to get data
- It’s much more efficient to collect and keep data on an ongoing basis



Example



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- C-5 Aft Crown Skins
- Stress Corrosion / Fatigue cracking
- Generated crack growth curve from known data point
- Performed risk assessment
- Shows risk approaching unity for current time
- Only one “large” crack found to date
- Obviously the crack growth / risk is wrong, right?



Example (Con't)



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- Not Necessarily!
- How many stress corrosion cracks have been found and repaired IAW TO 1C-5A-3 that we don't know about?
- A lot!
- Any of these could have grown into a large crack if undetected / unrepaired
- Risk curve could be correct, just mitigated by repair
- Difficult to persuade MAJCOM to act without believable risk categorization



Consider Data Management Up Front



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- How many other “Crises” could have been averted if data had been available to detect / predict trends?
 - Plan up front to collect and store maintenance data
 - What do you need to capture?
 - Inspections performed, results, repairs, R², etc.
 - Detailed description of deficiencies – with pictures
- How are you going to analyze it?
- Plan it into the system so that it’s easy for the technician to give it to you