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MERSİN KÖRFEZİNDE DENİZ DESARJI SİSTEMLERİNE
BAZ OLUŞTURACAK OSİNOGRAFIK ÇALIŞMALAR

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1.1 GİRİŞ

Orta Doğu Teknik Üniversitesi Deniz Bilimleri Enstitüsü, yapılması planlanan Mersin deniz deşarjları ilgili olarak, Mersin Körfezinde osinografik araştırmalar yapmıştır. Bu raporda fiziksel, kimyasal ve biokimyasal osinografik çalışmaların bulguları ve deęerlendirmeleri verilmiştir.

Çalışmaların kapsamında aşağıda verilen araştırmalar bulunmaktadır:

- 1) Bölge deniz suyunun fiziksel ve kimyasal özellikleri,
- 2) Akıntıları,
- 3) Bölgenin iklim özellikleri, ve rüzgar dalgaları.

Fiziksel veriler Bölüm-1'de, kimyasal ve bio-kimyasal veriler Bölüm-2'de verilmiştir.

Akıntılar ve deniz suyunun özellikleri bölgede yapılan ölçümler ile saptanmıştır. Rüzgar dalgalarının özellikleri empirik tahmin etme yöntemleri ile Mersin'e yakın (Erdemli' de) 1978-1979 seneleri arasında yapılmış ölçümleri kullanarak elde edilmiştir. Bölgenin hava ve deniz suyu sıcaklıkları, rüzgar, barometrik basınç ve nem oranları gibi iklimsel özellikleri Mersin meteorolojik verilerinden saptanmıştır.

1.2 SEFER TARİHLERİ, CİHAZLAR VE VERİ İŞLEME YÖNTEMLERİ

Veriler Şekil 1.1'de gösterilen istasyonlarda aşağıdaki tarihlerde alınmıştır.

1. 5 Aralık 1991 (fiziksel ve kimyasal parametreler)
2. 29 Nisan 1992 (kimyasal parametreler)
3. 29 Mayıs 1992 (fiziksel ve kimyasal parametreler)

4. 18 Ağustos 1992 (fiziksel ve kimyasal parametreler)
5. 2-3 Ekim 1992 (fiziksel ve kimyasal parametreler)

CİHAZLAR

Sıcaklık ve tuzluluk Sea Bird model 9 CTD prob sistemi ile ölçülmüştür. Prob su kolonundan aşağıya indirilirken derinliği, sıcaklığı ve iletkenliği saniyede 24 veri olarak ölçer. Sıcaklık ölçerinin doğruluğu 0.001°C ve iletkenlik ölçerinki ise 0.001 Siemenstir. Cihaz istenildiği takdirde verileri gemideki bilgisayara gönderebilir veya hafızasında saklayıp daha sonra işlenebilir. Bu çalışmada ikinci seçenek kullanılmıştır. Deniz çalışmalarından sonra her istasyonun verilerinin birer metre aralıklarla ortalama değerleri hesaplanmıştır.

Geminin konumunu ve akıntı ölçüm istasyonlarının yerlerini belirlemek için Decca Trisponder sistemi kullanılmıştır.

Akıntılar Aanderaa akıntı ölçeri ile ölçülmüştür. Bu cihaz otomatik olarak verileri, ayarlanmış örnekleme aralıklarında, bataryası yardımıyla manyetik kasetlere kayıt eder. Akıntı ölçer denizden çıkarıldıktan sonra veriler okunur ve mühendislik değerlerine çevrilir.

I.3 SICAKLIK TUZLULUK VE ÖZGÜL AĞIRLIK PROFİLLERİ

Yapılan dört sefer de sıcaklık tuzluluk ve özgül ağırlık sonuçları aşağıda belirtilen şekiller de verilmiştir:

Aralık	1991	Sekil I.2
Mayıs	1992	Sekil I.3
Ağustos	1992	Sekil I.4
Ekim	1992	Sekil I.5

Her sefer için iki grup profiller verilmiştir. Birinci grupta sıcaklık ve tuzluluk çizilmiştir. İkinci grupta sıcaklık ve özgül ağırlık parametresi sigma-t değerleri verilmiştir. Sıcaklık düz çizgi ile gösterilmiştir. Özgül ağırlık ve tuzluluk noktalı çizgi ile gösterilmiştir. Sığ istasyonlarda ancak bir metre derinlik için bir değer verilmiştir.

Aralık ayı verilerinde tuzluluk su kolonunda homojen bir dağılım göstermektedir; dipteki sıcaklık yüzey sıcaklığından bir az daha düşüktür. Bu sığ sularda, yüzey soğuması ve rüzgarlar yüzünden, suyun dik olarak karışmış olduğunu göstermektedir. Özgül ağırlık grafikleri su kolonunun üst 5-6 metresinde eşit derine doğru artan bir dağılım göstermektedir.

29 Mayıs seferinde yüzey sularda tuzluluk değerlerinde Aralık seferine göre bir azalma görülmüştür, yüzey sıcaklığında ise Aralık seferine oranla artış görülmüştür. Çünkü ilkbaharda, deniz suyuna nehirlerden tatlı su girdisinin ve ısınmanın etkisinin sonucunda olmuştur. Limanın doğusunda kıyıya yakın M-5, M-6 ve M-7 istasyonlarında yüzey tuzluluğu oldukça düşük, yaklaşık 34 ppt seviyesindedir. Kıyıdan uzak olan M-31 ve M-32 gibi istasyonlarda sıcaklık tabandan yüzeye 4 C artış göstermektedir. Bu istasyonlarda tuzluluk yüzeyde 37 ppt tabanda ise 39 ppt civarındadır. Bunun nedeni çalışma alanında tatlı suyun tuzlu su üzerine yayılmasıdır. Özgül ağırlık verileri su kolonunda iki katmanlı bir yapının oluşmaya başladığını göstermektedir. Bu ilkbahar ve yaz aylarındaki artan ısınma ile uyumludur.

Ağustos ayında yüzey sıcaklığı 30 C ye kadar artmıştır. Su kolonundaki üst 7 metrede tuzluluk ve sıcaklıkta homojen bir dağılım görülmektedir. Özgül ağırlık verileri de aynı iki katman yapısını ortaya çıkarmıştır. Üst 7 metredeki özgül ağırlık değeri 24 sigma-t'dir ve dibe doğru 25.8 sigma-t seviyesine kadar artmaktadır.

Ekim ayında tuzluluk verileri dikeyde homojen dağılım göstermektedir, ancak sıcaklık yüzeyde daha fazladır. Bunun sebebi su kolonunun

kuvvetli rüzgarlardan karışması ve daha sonra güneş ışınları tarafından ısınmasıdır. Özgül ağırlık verileri dikeyde eşit dağılım göstermektedir.

M-32 istasyonundaki sıcaklık tuzluluk ve özgül ağırlık verileri Şekil I.6 da bütün seferler için yıllık değişimi göstermek için verilmiştir (Aralık seferi için M-18 istasyonu kullanılmıştır.). Şekil I.6'dan sahile yakın bu sığ bölgelerdeki su kolonunun Ekim ile Nisan ayları arasında karışmış ve homojen olduğu görülmektedir. Bunun nedeni kıs fırtınalarının kuvvetli rüzgarları ve soğuk havanın etkisiyle dikey su kolonunun iyi karışmış bir duruma gelmesi ve böylece dikeyde eşit dağılımlı bir yapı ortaya çıkmasıdır. İlkbaharda havaların ısınmasıyla yüzey suyu daha hafif bir hale geliyor ve su kolonu iki katman yapısı göstermeye başlıyor. Yaz aylarında suyun daha da ısınması ve rüzgarların azalması dolayısıyla iki seviyeli bu yapı Ağustos ayında daha belirgin olur ve bu durum Ekim ayına kadar devam eder.

I.4 AKINTI ÖLÇÜMLERİ

Akıntı ölçümleri, istasyonlarda yerleştirilen akıntı ölçerler ile, 22 Nisan - 12 Mayıs 1992 ve 22 Temmuz - 13 Ağustos 1992 tarihleri arasında yapılmıştır.

İstasyon yerleri Nisan için Şekil I.7'de, Temmuz için Şekil I.8'de gösterilmiştir. Ölçüm istasyonları cihazların seri numaraları ile belirlenip derinlikleri aşağıda verilmiştir.

Nisan 1992 (Şekil I.7)

RCM 4819	toplam derinlik:	5m.	akıntı ölçüm derinliği:	2.5m.
RCM 2905	toplam derinlik:	6m.	akıntı ölçüm derinliği:	2.5m.
RCM 6625	toplam derinlik:	8.5m.	akıntı ölçüm derinliği:	5.0m.
RCM 6687	toplam derinlik:	10m.	akıntı ölçüm derinliği:	5.0m.

Temmuz 1992 (Sekil I.8)

RCM 2905 toplam derinlik: 11.5m. akıntı ölçüm derinliği: 6.0m.

RCM 6625 toplam derinlik: 11.5m. akıntı ölçüm derinliği: 6.0m.

Nisan'da ölçümler 10 dakikada bir, Temmuz'da 20 dakikada bir yapılmış, her ikisinde de saatlik veriler ortalama alınarak bulunmuş ve bu değerler grafiklerde kullanılmıştır. Akıntı verilerinin değerlendirilmesinde rüzgar hızı vektörleri de (Bölüm I.5) dikkate alınmıştır. Veriler üç değişik şekilde gösterilmiştir:

1. Akıntı hızı zaman serileri
2. Akıntı hızı vektör zaman serileri, ve
3. İlerleyen vektör seması.

NİSAN - MAYIS AKINTILARI

Sekil I.9 ve I.10, 22 Nisan - 12 Mayıs tarihleri arasında yapılan akıntı hız ölçümlerinin zaman serilerini göstermektedir. Ortalama akıntı hızları aşağıda verilmiştir:

RCM 6625	14.9 cm/s
RCM 6687	21.6 cm/s
RCM 4819	23.5 cm/s
RCM 2905	28.8 cm/s

Akıntı ölçüm istasyonu CM6687'nin sıcaklık ve tuzluluk zaman serileri Sekil I.11'de verilmiştir.

Akıntı hızı vektör zaman serileri Sekil I.12-I.15'de verilmiştir. Bu grafiklerde saatlik ortalama akıntı hızı okla gösterilmiştir. Okun uzunluğu hızın göstergesi olarak, (1 cm = 20 cm/s) ve okun yönü akıntının akış yönünü göstermektedir. Kuzey grafiğin yukarısına doğru, doğu grafiğin sağına doğrudur.

Bu akıntı ölçüm dönemi için limanın batısındaki akıntıların rüzgarla uyumlu olduğu, bunun yanı sıra limanın doğusundaki akıntıların

yönlerinde değismeler olduđu gözlenmiştir.

Limanın batısında, CM 6625 ve CM 6687'nin akıntı hızı vektörlerinin kuzeydođu yönünde belirgin bir bileşkesi olduđu gözlenmiştir (Şekil I.12 ve I.13). Nisan ve Mayıs 1992 için rüzgar hızı vektörü zaman serileri (Bölüm I.5), 22 Nisan - 3 Mayıs tarihleri arasında rüzgarın güneybatı ve kuzeydođu bölgelerinden değismeli olarak estiđini, ancak daha kuvvetli rüzgarların güneybatıdan (kuzeydođuya dođru) estiđini göstermektedir. Bu dönemdeki akıntı yönü hakim olarak kuzeydođuya dođrudur, ve bu gözlem rüzgarla uyumludur (Şekil I.12-I.13). 4-7 Mayıs tarihleri arasında değisik yönlerden esen rüzgarlar gözlenmiş, aynı zamanlarda (gün 12-15, Şekil I.12-I.13) limanın batısındaki akıntılarda da (rüzgara bađlı olarak) yön ve hız değisiklikleri gözlenmektedir.

Limanın doğusunda akıntılarda hakim bir yön bulunmamaktadır (CM 4819, Şekil I.14 ve CM 2905, Şekil I.15). İlk beş günkü ölçümlerde akıntı başlıca batı yönündedir ve bu limanın batısındaki akıntı ve rüzgar yönünün tersindedir. Bundan sonraki verilerde akıntı yönü değisken olup rüzgarla belirgin bir ilişki gözlenmemektedir. Bölgesel akıntıları bir bütün olarak inceleyebilmek için akıntı hızı her istasyon için ilerleyen vektör seması şeklinde çizilmiştir. Bu grafikler saatlik ortalama hız vektörlerinin sırayla çizilmesiyle oluşturulmuştur. CM 6625 için (Şekil I.16) akış yönü ilk 13 gün için doğu-kuzeydođu yönünde, daha sonra değiskenidir. Kıyıda daha uzak CM 6687 için (Şekil I.17) ufak değisiklerle kuzey doğu yönündedir. Bu gözlemler rüzgarla uyumludur, ve akıntılarının güney ve güneybatıdan gelen rüzgarlara bađlı olduđunu, güney rüzgarları arasında periodik olarak görülen zayıf kuzey rüzgarlarından etkilenmediđini göstermektedir. Dođu tarafında (CM 4819 Şekil I.18) akıntı ilk 6 gün batıya dođrudur, daha sonra yönde değisimleri gözlenmektedir. Kıyıda daha uzakta olan CM 2905'de akıntı başta genelde batı yönündedir, altıncı günden sonra kuzey dođuya dođru yön değistirmiştir (bakınız Şekil I.19). Yön değisimleri burda da gözlenmiştir.

Yukarıda anlatılan akıntılar limanın doğusunda saatin ters yönünde dönen bir anaforun oluştuğunu göstermektedir ve bunun sonucu kıyıya yakın akıntı açığına ters bir akıntı oluşturmıştır. Limanın doğusundaki ölçüm istasyonlarının ikisinde bu anafordan etkilenmesi sonucu akış semaları limanın batısındakilerden farklı çıkmıştır. Bu neden ile yazın akıntı ölçüm istasyonları, anaforun dışındaki akıntıları belirlemek için daha açığına yerleştirilmiştir.

TEMMUZ-AĞUSTOS AKINTILARI

Sekil I.7, 22 Temmuz-13 Ağustos tarihleri arasında yapılan akıntı ölçümleri istasyonlarını göstermektedir. İstasyonlar Nisan - Mayıs aylarından 2 metre daha derine konmuştur. Akıntı ölçerler denizden çıkarıldığı zaman cihazların üstünün bol miktarda yosun ve deniz organizmaları ile kaplandığı görülmüştür. Bu oluşum ölçümlerin son zamanlarında pervane'nin hareketine engel olmuştur. Hızın zaman serileri grafiğinden de (Sekil I.20) görüldüğü gibi, 12'inci günden sonra hız gittikçe azalmaktadır. İlk oniki günlük verileri kullanarak ortalama hızlar aşağıda belirtilmiştir.

RCM 6825	22.6 cm/s
RCM 2905	24.0 cm/s

Temmuz ve Ağustos rüzgar verileri (Bölüm I.5) bölgenin yazın tipik rüzgar oluşumlarını desteklemektedir. Rüzgar öğleden sonra güneybatıdan, geceleyin kuzeydoğudan esmektedir. Akıntı hız vektör zaman serileri Sekil I.21 ve I.22'de, ilerleyen hız vektör seması Sekil I.23 ve I.24'de, CM 6625 için sıcaklık ve tuzluluk zaman serileri Sekil I.25'de gösterilmiştir. Her iki istasyondaki ölçümlerin aynı olması, döngünün dışında kalıp aynı akışa mahruz kaldıklarının göstergesidir. Akıntı rüzgarla değişmekle beraber esas itibarıyla kuzeydoğu yönündedir. Bu sonuç rüzgar verilerinin denizden esen rüzgarın karadan eseninden daha güçlü olduğu gözlemiyle uyumludur.

Akıntı verileri su şekilde özetlenebilir: kıyıya yakın ve sığ olan bu bölgede akıntıların oluşmasının hakim etken rüzgardır. Liman açıklarında her iki ölçüm dönemindedeki akıntının (bir kaç değişikliklere rağmen) genel olarak doğuya doğru olduğu gözlenmiştir. Limanın doğusunda kıyıya yakın bölgede ufak ölçekli ve saat yönünün tersinde bir anaforun meydana geldiği gözlenmiştir. Temmuz - Ağustos ölçümlerinde bu anafor gözlenmemiştir. Nedeni de bu dönemin akıntı ölçüm istasyonlarının öncekinden daha açıkta olduğu düşünülmektedir. Bu gözlem, limanın doğusundaki anaforun yaklaşık olarak Temmuzdaki akıntı ölçüm istasyon mevkiisi ile sınırlı olduğunu göstermektedir. Akıntı hızları ise genel olarak 20-25 cm/s seviyesindedir, ancak Nisandaki CM 6625 (Batı dalga kıranına en yakın olan) istasyonunda ortalama hız 15 cm/s olarak ölçülmüştür.

I.5 İKLİMSEL ÖZELLİKLER

RÜZGARLAR

Bölgedeki rüzgar durumu Ekim ile Nisan arasında siklonik sistemlere, ve yılın geri kalan aylarında da deniz ve karadan esen yöresel rüzgarların durumuna bağlıdır. Kış boyunca rüzgarın yönü ve hızı yöredeki siklonik sistemlerin geçiş yönüne bağlıdır, yaz döneminde ise denizden esen (güneybatı yönünde) rüzgarlar belirleyicidir. Bölgede zaman zaman esen güçlü kuzeydoğu rüzgarları da (Poyraz adıyla bilinen) mevcuttur. 1992 için (Ocak-Ekim) saatlik ortalama rüzgar hızı vektörleri Şekil I.26'da verilmiştir. Bu yıl Ocak ayı boyunca rüzgarların hafif olduğu gözlenmekle birlikte genelde böyle olmadığı bilinmektedir. Güçlü güneybatı rüzgarları Şubat'ın ortasından Mayıs'a kadar gözlenmiş. Yaz rüzgarları ise Haziran'dan Ekim'e kadar devam etmiştir.

1992 için en hızlı esen rüzgar verileri Tablo I.1'de verilmiştir. Kış boyunca hakim rüzgarlar kuzeydoğu ve güneybatıdan, yaz boyunca da güneybatıdan esmektedir. Mayıs ayında üç defa kuzeydoğu ve doğu-kuzeydoğu yönünden esen rüzgarların hızınının 10 m/s'yi geçtiği

gözlenmiştir. 1992'de rüzgar yönünün aylık frekans yüzdesi Sekil I.27'de gösterilmiştir. Rüzgar hızının 1 m/s'den düşük olduğu zamanlar (sakin) olarak kabul edilmiş ve bu sayı her ay için belirtilmiştir.

1977-1991 yılları arasındaki rüzgar vektör hızı grafikleri (Sekil I.28-I.42) uzun vadeli rüzgar karakteristiğini belirlemektedir. Bu grafiklerde gün boyunca 3 defa yapılan ölçümler (07:00, 14:00 ve 21:00) kullanılmıştır. Rüzgarın yaz ve kış dönemlerindeki farklılıklarının yanı sıra yıllara göre de değişiklikler gözlenmektedir. Her yıl için rüzgar yönünün frekans yüzdesi Sekil I.43'de verilmiştir. Burdan da görüldüğü gibi kuzeydoğu, kuzeybatı ve güneybatı yönlerinden esen rüzgarlar hakimdir. Aylık rüzgar frekansları da Sekil I.44'de gösterilmiştir. Kuzeydoğu ve kuzeybatı bölgelerinden esen rüzgarlar kış aylarında (Kasım - Mart) , güneybatıdan esenler de yaz aylarında belirgindir. Kışın güneybatıdan esen rüzgarların seyrek olduğu görülmekle beraber güneydoğu ve güneybatı bölgelerinden de kuvvetli rüzgarlar gözlenmiştir. Bu gözlemler Tablo I.1 ile desteklenmektedir. Bu rüzgarlar sinoptik haritalarda daha belirgin olarak görülmektedir. Türk Deniz Kuvvetlerinin bir yayınında (1984) aşağıdaki tarih ve fırtına yönleri derlenmiştir. Fırtınadan rüzgar hızının 16 m/s'den yüksek olduğu haller alınmıştır.

3 Mart 1953	Kuzey
27 Ocak 1959	Güneybatı
13 Ocak 1968	Güneybatı

BAROMETRİK BASINÇ

1981 - 1990 yılları arasındaki bazı tipik basınç grafikleri Sekil I.45'de gösterilmiştir. Bu grafiklerde, basınç değişimlerinin gözlenebilmesi için ortalama değeri çıkarıldıktan sonra çizilmiştir. En çok değişim kış aylarında siklonik sistemlerin geçtiği 3-5 günler süresince gözlenmiştir. Subat-Mart 1985 ve Ocak 1987 ortalarında gözlemlendiği gibi zaman zaman yüksek basınç sistemi bölgede genelde

sakin ve acık hava sartları yaratır. Sekil I.46'da 1992 için aylık basınc grafikleri gösterilmiştir. Rüzgar verileri ile yapılan karşılastırmalar sonucu güçlü rüzgarların basınc değışimlerinin 2-3 gün süreleri içinde olduđu gözükmetedir (19 Subat, 10-12 ve 18 Mart, 12-13 ve 20 Nisan tarihlerinde olduđu gibi). Siklonik sistemin yaklaşması ile basıncın düşüp güneybatı yönünden rüzgarın çıktığı, sistemin doğu yönünde bölgeden uzaklaşması ile basıncın artıp rüzgarın kuzey yönüne döndüđu gözükmetedir.

RÜZGAR DALGALARI

Mersin limanı, dalga hareketine güneybatı ve güneydođu yönlerinden açıktır. Acık denizde dalga yüksekliđi, rüzgarın siddetine, esme süresine ve rüzgarın etkili olduđu mesafeye bađlıdır. Kıyıya doğru dalga yüksekliđi, kırılma ve deniz tabanının sıđlaşması ile azalmaktadır. Mersin için rüzgarın etkin olduđu en uzun mesafe fırtınanın doğu Akdeniz'de Girit adası civarında olduđu hallerdedir. Ancak Mersin bölgesi güneydođu ve güneyden gelen dalgalara Kıbrıs adasından dolayı bir miktar korunmalıdır. Siklonik sistemlerin yolu Akdeniz'de batıdan doğuyadır, ve fırtınanın merkezi Kıbrıs'tan geçtiđi taktirde güneydođu yönünde kuvvetli rüzgarlar oluşmaktadır. Bu durumda rüzgarın etkili olduđu alan 150 deniz milidir, fakat bu durumda dalgalar kıyıya bir engelle karşılastmadan gelebilmektedir. Sonucta güneybatı yönündeki dalgalar daha sık olduđu, ancak kıyı güneydođudan da kuvvetli dalga etkisine açıktır. Bu çalışmada, dalga özellikleri saptamak için 1977-1990 yılları arasındaki sinoptik haritalar kullanılmıştır. Derin deniz dalga karakteristik ölçülen verilerle karşılastırılmış ve dalga yüksekliđinin azalma faktörü empirik olarak bulunmuştur. Derin deniz dalga karakteristikini bulmak için kullanılan yöntem "Shore Protection Manual" (1973) da verilmiştir. Bu yaklaşım ve diđer benzer yaklaşımlar subjektif olduđu için bazı hatalara açıktır. Örneđin, rüzgarın estiđi alanın, ve bölgede fırtınadan önce mevcut dalgaların saptanması zordur.

Dalga verileri 1978-1979 seneleri arasında Orta Doğu Teknik Üniversitesi, Deniz Bilimleri Enstitüsü tarafından Erdemli'de ölçülmüştür. Veriler "Datawell" dalga samandırması ile ölçülmüştür. Samandıra 30 metre derinliğe demirlenmiştir. Kasım 1978 - Nisan 1979 aylar arasında 2-3 metre yüksekliğinde dalgalar sık olarak ölçülmüştür. En yüksek dalga yüksekliği 7 Mart 1979' da 4 metre olarak ölçülmüştür. Bazı fırtına ve dalga ölçüm örneklerinden aşağıda bahsedilmiştir. Sinoptik haritalar Şekil I.47'de ve dalga verileri Şekil I.48'de verilmiştir.

Şekil I.47(a) Aralık 15, 1978'deki sinoptik haritayı gösteriyor. Fırtına merkezi Karadeniz'dedir. Hesaplanan dalga yüksekliği 4.5 metredir. Ölçülen dalga verileri Şekil I.48(a)da gösterilmiştir. Ortalama dalga yüksekliği 1 metre ve maksimum dalga yüksekliği 2.5 metredir. Bu ikisinin arasındaki oran $(2.5/4.5)$ 0.55 dir. Şekil I.47(b) 3 Ocak 1979'daki durumu gösteriyor. Bu durumda fırtına merkezi Ege denizindedir. Tahmin edilen dalga yüksekliği 5.8 metredir. Ölçülen dalga değerleri Şekil I.48(b)'de gösterilmektedir. Ortalama dalga yüksekliği 1.8 metredir, maksimum dalga yüksekliği 2.8 metredir, bu bize $(2.8/5.8)$ 0.48'lik bir oran vermektedir. Şekil I.47.(c) 7 Mart 1979'da merkezi Kıbrıs'ın güneybatısında olan üçüncü bir sistemi göstermektedir. Bu durumda tahmin edilen dalga yüksekliği 6 metredir. Şekil I.48 (c) de ölçülen dalga verileri, ortalama dalga yüksekliğini 2.4 m. ve maksimum dalga yüksekliğini de 4 m. olarak gösteriyor. Maksimum dalga yüksekliğinin tahmin edilen dalga yüksekliğine oranı $4/6$ veya 0.67 dir. Mersin civarında olası maksimum dalga yüksekliğini hesaplamak için, sinoptik haritalarda yapılan araştırma , Şekil I.47(d) de gösterilen 18 Ocak 1985 tarihindeki fırtınanın bölgeden geçen tipik bir sert fırtına olduğunu göstermiştir. İzobarlar arasındaki aralıklardan hesaplanan rüzgar hızı 55 knot'tur. Rüzgarın etkin olduğu alan 150 deniz milidir, ve tahmin edilen dalga yüksekliği 9 metredir. Ortalama (0.55) oranı kullanarak, kıyıda beklenen maksimum dalga yüksekliği 5 metre ve ortalama dalga yüksekliği 3 metre olacaktır. 7 Mart 1979 daki fırtınada beklenen dalga periodu 10 saniyedir fakat gözlenen dalga periodu 4.5 saniyedir. 18 Ocak 1985

fırtınasında tahmin edilen dalga periodu 12 saniyedir, bundan dolayı gözlenecek dalganın periodu 6 saniye civarında beklenmelidir. Bu tahmin edilen dalga yüksekliği ve periodu Erdemli'de ölçülen verilere göre mantıklı olduğu düşünülmektedir. Bu hesaplanan dalga yüksekliği, çok uzun zamanda, örnek 100 senede bir, meydana gelebilecek en yüksek dalga değildir, ancak 10-15 senede olabilecek dalga yüksekliğidir.

HAVA VE DENİZ SUYUNUN YÜZEY SICAKLIKLARI

1981-1991 yılları arasındaki yıllık hava değişimleri Şekil I.49 da verilmiştir. Genelde en düşük sıcaklık Şubat ve Mart aylarında olmak üzere 9°C , en yüksek sıcaklık ise Temmuz ile Ağustos aylarında olmak üzere $28-30^{\circ}\text{C}$ dir. Özellikle düşük sıcaklıkların derecesi ve zamanında yıllara göre bir değişim vardır. Ocak 1983, Şubat 1985 aylarında hava sıcaklığı 2°C 'ye kadar düşmüştür. 1984 yılında Ocak ve Mart aylarında 12°C gibi yüksek sıcaklıklar ve Aralık ayında ise en düşük sıcaklıklar gözlenmiştir. 1987 yılında Ocak ve Şubat ayında ortalama sıcaklık 12°C civarında olmuştur, ancak Mart ayında sıcaklık 8°C 'ye kadar düşmüş ve yazın başına kadar ortalamanın altında kalmıştır.

1985-1990 yılları arasındaki deniz suyu yüzey sıcaklıkları Şekil I.50 de gösterilmiştir. En düşük sıcaklık Şubat - Mart arasındaki 13°C ila 15°C dir ve en yüksek sıcaklık ise Temmuz - Ağustos arası 28°C ila 29°C dir. Hava sıcaklıklarında olduğu gibi deniz suyu sıcaklığında yıllar arasında değişimler göstermektedir. 1985 yılının Mart ayında sıcaklık 11°C 'ye düşmüştür, bu durum ortalamanın 3°C altındadır. 1987 yılında, hava sıcaklığında olduğu gibi, deniz yüzeyi sıcaklığı Mart ayında ortalamanın 2°C altına düşmüştür ve yazın başına kadar ortalama değerinin altında seyretmiştir.

NİSPİ NEM

1941-1990 yılları arasındaki nispi nem değerleri Şekil I.51'de verilmiştir. Bu şekilde aylık ortalama nispi nem değerleri çizilmiştir. Bu değerler Tablo I.2'de verilmiştir.

I.6 FİZİKSEL VE İKLİMSEL VERİLERİN ÖZETİ

Arastırma yapılan bölgenin sahile yakın ve derinliğinin az olması nedeni ile deniz suyunun sıcaklığı, tuzluluğu ve katmanlaşması kıyıda gelen tatlı su girdisi ve bölge rüzgarlardan etkilenmektedir. Su kolonu Ekim ile Nisan ayları arasında homojen bir durumdadır. Katmanlaşma, Mayıs ayında başlar ve Ağustos -Eylül aylarında belirgin hale gelir. Katmanlaşmış durumda üst tabakanın kalınlığı yaklaşık 8 metredir. Bu tabakanın sıcaklığı Ağustos ayında 29 -30 °C civarındadır.

Çalışma bölgesindeki akıntılar esas itibariyle rüzgarlar tarafından belirlenmektedir. Kış boyunca belirgin rüzgarlar kuzeydoğu-kuzeybatı yönlerinden esmekle beraber siklonik sistemlerin geçmesiyle güneybatı ve güneydoğu yönünden de kuvvetli rüzgarlar gelmektedir. Yaz boyunca denizden ve karadan esen rüzgarlar sistemi oluşmaktadır. Güneybatıdan esen rüzgarlar daha kuvvetlidir. Neticede akıntının hakim olduğu yön Kuzeydoğudur. Kış aylarında akıntılar fırtınaların değişik yönlerden gelen rüzgarlara bağımlı olup değişken olması beklenir. Batı'dan doğu'ya doğru olan akıntı limanın doğusunda kıyı yakınlarında saatin ters istikametinde dönen bir anafor yaratmaktadır. Anaforun etkisinin limanın açıklarında kaybolduğu görülmüştür.

Mersin bölgesi güneybatı ve güneydoğu yönlerinden gelen dalgalara açıktır. Mersin'e yakın Erdemli'de 4 m. yüksekliğindeki dalgalar ölçülmüştür. Son 15 senenin sinoptik haritalarını kullanarak yapılan tahminler bölgede maksimum dalga yüksekliğinin 5 m. olduğunu göstermiştir.

II. MERSİN KÖRFEZİNİN BİYOKİMYASAL ÖZELLİKLERİ VE KÖRFEZDE KİRLENME

II.1. KARA KÖKENLİ KAYNAKLARDAN KİRLENME

Mersin'in su anda kullanılmakta olan kanalizasyon sisteminin denize desarj noktasında bazı biyokimyasal ve kirletici parametreler periyodik olarak takip edilmiştir. Benzer ölçümler, Mersin körfezine dökülen Delicay ve Muftu dereleri ile Cavuşlu kanalında da iki aylık periyotlarla yapılmıştır. Bu Raporda sunulan bulgulara ait kısaltmalar, semboller ve birimler Ek A' da verilmiştir. Ek B' de ise bu çalışmada ölçülen biyokimyasal ve kirletici parametrelere ait analiz metodlarından kısaca bahsedilmiştir. İki aylık aralıklarla kanalizasyon atık suyunda ve uç akarsuda ölçülen biyokimyasal ve kirletici parametrelere ait sonuçların tümü Çizelge II.1' de verilmiştir.

pH:

Uç akarsuda ölçülen pH, 7.42 ile 8.96 arasında değişmektedir ve genelde minimum değerler sonbaharda, maksimum değerler ise ilkbahar başlangıcında kaydedilmiştir. Akarsularda ölçüm noktalarının denize yakın olması nedeniyle bu noktalarda karışımdan dolayı kuvvetli bir tampon olan deniz suyunun pH' sına (8.2) yakın değerler elde edilmiştir. Mersin kanalizasyon desarjınının pH' sı ise akarsulara oranla daha düşük ölçülmüştür. Mersin desarjında ortalama pH 7.63 olarak hesaplanmıştır ve minimum değer 6.89 olarak kaydedilmiştir. Aralık 1991-Ekim 1992 tarihleri arasında Mersin desarjında ölçülen pH değerleri evsel atıklar için verilen limitleri aşmamaktadır (Su Kirliliği Kontrolü Yönetmeliği, 4-Eylül-1988, No. 19919, Resmi Gazete).

Cozunmus Oksijen: (CO, DO):

Uç akarsuda Çözünmüş Oksijen konsantrasyonu 7.5-10.2 mg/L aralığında ölçülmüştür. Maksimum Çözünmüş Oksijen konsantrasyonu, kış koşullarında tüketimin azalması ve çözünürlüğün su sıcaklığı düştükçe artması nedeniyle Subat 1992' de ölçülmüştür. Mersin desarjında ortalama Çözünmüş Oksijen 8.5 olarak hesaplanmıştır. Bu değer kanalizasyon atık suları için oldukça yüksek bir değerdir ve bunun sebebi desarjın havaya açık olması ve havanın oksijeninden direk olarak etkilenmesidir.

Biyokimyasal Oksijen İhtiyacı (BOI₅):

Bilindiği üzere, Biyokimyasal Oksijen İhtiyacı (BOI₅), sudaki organik maddenin biyolojik (bakteriyel) olarak parçalanması sırasında gerekli oksijenin bir ölçüsüdür ve BQI ' in yüksek olması, söz konusu ortamda doğal veya kirletici organik yükün fazla olduğunu göstermektedir. Akarsularda bir yıl boyunca iki ay aralıklarla ölçülen BOI₅ değerleri 2.6 ile 3.3 mg/L arasında değişmektedir. Delicay, Cavuslu ve Muftu derelerinden toplam BQI₅ yükü ise sırasıyla 2.6×10^2 , 0.3×10^3 ve 1.9×10^2 ton/yıl olarak hesaplanmıştır. Bu değerler Kuzeydoğu Akdeniz'e dökülen büyük nehirlerle karşılaştırıldığında oldukça düşük değerlerdir. Örneğin BQI₅ yükü, Ceyhan için 39.9×10^3 ton/yıl, Seyhan için 44.9×10^3 ton/yıl ve Göksu için 6.3×10^3 ton/yıl olarak hesaplanmıştır (Yılmaz ve diğ., 1992a). Mersin kanalizasyon desarjının ortalama BOI₅ konsantrasyonu ise 186.2 mg/L olarak hesaplanmıştır ve bir yıllık zaman süresince 339 mg/L gibi oldukça yüksek değerler ölçülmüştür. Bu desarjın Mersin körfezine verdiği toplam BOI₅ yükü ise 3.5×10^3 ton/yıl olarak hesaplanmıştır. Teorik olarak bir kişinin günde 25-70 g BOI₅ yüküne neden olduğu ve Mersin' de nüfusun ortalama 500.000 olduğu varsayılırsa buradan hesaplanan ve körfeze verilen toplam BOI₅ yükünün 4.5×10^3 ton/yıl ile ölçülen gerçek değerle uyum içerisinde olduğu açıklıkla görülmektedir. Mersin desarjının ortalama BOI₅ konsantrasyonu Su Kirliliği Kontrolü Yönetmeliğinde evsel atıklar için verilen üst limite yakındır (4-Eylül-1988, No. 19919, Resmi Gazete).

Kimyasal Oksijen İhtiyacı (KOİ):

Bazı organik maddelerin normal şartlar altında mikroorganizmalar tarafından biyolojik olarak parçalanması (oksitlenmesi) çok güçtür; ancak bu tür maddeler yüksek sıcaklıkta ve kuvvetli asidik ortamda kimyasal olarak parçalanabilirler. Bu nedenle, Kimyasal Oksijen İhtiyacı (KOİ) olarak bilinen ve kimyasal olarak parçalanabilen organik yükü temsil eden bu parametre ile su ortamında toplam kirletici organik yükün (biyolojik ve kimyasal) seviyesi hakkında fikir sahibi olmak söz konusudur. Üç akarsuda ölçülen KOİ konsantrasyonları 68.1-148.9 mg/L aralığında değişmektedir ve Delicay, Cavuslu ve Muftu derelerinden Mersin körfezine giren toplam KOİ yükü sırasıyla 13.9×10^3 , 0.7×10^3 ve 9.2×10^3 ton/yıl olarak hesaplanmıştır. Genelde KOİ konsantrasyonu ve dolayısıyla toplam yükün, BOİ'nin iki katı olması beklenir; ancak Mersin bölgesindeki akarsularda KOİ/BOİ oranının çok yüksek olduğu tespit edilmiştir. Bu durum da bu akarsulara fazla miktarda endüstriyel atık desarj edildiğini göstermektedir. Mersin desarjında ise KOİ konsantrasyonunun BOİ konsantrasyonunun hemen hemen iki katı olduğu tespit edilmiştir ki bu evsel özellikteki atıklar için normal bir orandır. Mersin desarjından körfeze toplam 6.4×10^3 ton/yıl KOİ'ye eşit organik yükün verildiği hesaplanmıştır.

Toplam Asılı Katı (TAK):

Mersin körfezine dökülen Üç akarsuda Toplam Asılı Katı (TAK) 4.4-9.2 mg/L aralığında ölçülmüştür. Bu, iki aylık aralıklarla sürdürülen izleme çalışmalarında en yüksek TAK değerleri akarsu debilerinin artması tasdıqları madde miktarında artış nedeniyle Mayıs 1992' de kaydedilmiştir. Delicay, Cavuslu ve Muftu derelerinde Toplam Asılı Katı yükü sırasıyla 4.1×10^2 , 0.5×10^2 ve 6.6×10^2 ton/yıl olarak hesaplanmıştır. Mersin kanalizasyon desarjının ortalama TAK konsantrasyonu ise 100 mg/L olarak hesaplanmıştır ve bu desarjdan körfeze yılda toplam 1.9×10^3 ton asılı katı girmektedir.

Besin Tuzlari:

Bu izleme çalışmasında Mersin körfezine dökülen üç akarsuda ve su anda faaliyette bulunan Mersin kanalizasyon desarjında besin tuzu konsantrasyonları da ölçülmüştür. Toplam inorganik fosfat₄ (PO₄) yükleri Delicay, Cavuslu ve Muftu dereleri için sırasıyla 1.32, 2.50 ve 1.33 ton/yıl olarak hesaplanmıştır. Bu üç akarsuyun toplam fosfor (organik+inorganik) girdileri ise yine aynı sırayla 2.87, 2.50 ve 1.76 ton/yıl olarak hesaplanmıştır. Bu sonuçlar, bu desarjdan körfeze verilen toplam fosforun önemli bir kısmının çözünmüş inorganik fosfat olduğunu göstermektedir. Diğer yandan Mersin kanalizasyonundan körfeze yılda 41.9 ton inorganik fosfat ve 66.5 ton toplam fosfor girmektedir ve bu değerler akarsulardan olan girdiler ile karşılaştırıldığında oldukça fazladır.

Delicay, Cavuslu ve Muftu derelerinden körfeze olan toplam oksitlenmiş azot (NO₃-NO₂) girdileri ise sırasıyla 153.6, 22.7 ve 64.4 ton/yıl olarak hesaplanmıştır. Fosfor girdilerinin tersine Mersin desarjından körfeze giren azot miktarı 1.2 ton/yıl olarak hesaplanmış ve bu değer akarsulardan olan azot girdileri ile kıyaslandığında çok düşük olduğu gözlenmiştir. Buna neden tarım alanlarında kullanılan azotlu suni gübrelerin akarsular vasıtasıyla körfeze taşınmasıdır.

Poliaromatik Petrol Hidrokarbonlari (PAH):

Kıyı sularında petrol kirlenmesine en fazla kıyıda bulunan petrol rafinerileri, endüstri kuruluşları ve evsel atıklar neden olmaktadır. Bu izleme çalışmasında, Mersin körfezine dökülen üç akarsuda ve Mersin şehir kanalizasyonunda çözünmüş/dağılmış poliaromatik petrol hidrokarbonları ölçülmüş ve körfeze girdiler hesaplanmıştır. Ortalama PAH konsantrasyonu Cavuslu ve Muftu dereleri için 0.52 ve 0.36 µg/L olarak hesaplanmıştır. Delicay deresinde ise PAH konsantrasyonu ortalaması 3.1 µg/L dir. Bu akarsuda petrol kirlenmesinin yüksek düzeyde olmasının nedeni Delicay mevkiinde rafineri bulunması ve irili-ufaklı petrol endüstrisinin bölgede faaliyet göstermesidir. Bu akarsulardan toplam petrol ve petrol ürünleri girdisi

5.3-290 kg/yıl aralığındadır. Mersin kanalizasyon desarjında PAH konsantrasyonu ortalama 148 µg/L olarak ölçülmüştür ve bu evsel atık vasıtasıyla körfeze yılda 2.8 ton petrol taşınmaktadır.

Ağır Metaller: Civa ve Kadmiyum (Hg ve Cd):

Deniz ekosistemleri için toksik olan metallerden birisi olan Civa, Mersin körfezine dökülen uç akarsuda ve Mersin kanalizasyon desarjında iki aylık periyotlarla ölçülmüştür. Akarsularda Civa konsantrasyon aralığı 0.6 ile 6.0 ng/L olarak, Mersin desarjında ise konsantrasyon yüksek olup 1.9-8.4 ng/L aralığında tespit edilmiştir. Delicay, Cavuslu ve Muftu derelerinden toplam Civa girdisi sırasıyla 159.5, 25.2 ve 216.6 g/yıl olarak hesaplanmıştır. Mersin desarjından körfeze giren Civa, akarsulardan giren miktarlarla kıyaslanabilecek bir seviyededir ve 70 g/yıl olarak hesaplanmıştır. Çözülmüş Kadmiyum konsantrasyonu Mersin körfezindeki kara kaynaklı kirletici atıklarda (akarsular ve kanalizasyon atığı) 0-2.85 ng/L aralığında ölçülmüştür. Bununla beraber asılı katıya tutunmuş şekilde bulunan Kadmiyum konsantrasyonu 0-818.4 ng/L gibi çok geniş bir konsantrasyon aralığında ölçülmüştür. Delicay, Cavuslu ve Muftu derelerinden toplam Kadmiyum girdisi sırasıyla 14.7, 0.9 ve 4.2 kg/yıl olarak hesaplanmıştır. Mersin kanalizasyon desarjında asılı katıdaki Kadmiyum konsantrasyonu Ekim 1992'de 3318 ng/L kadar yüksek ölçülmüş ve bu desarjda bir yıllık ortalama asılı katıdaki Kadmiyum 881.8 ng/L olarak hesaplanmıştır; bu da 16.7 kg/yıl kadar Kadmiyumun körfeze bu kaynakla taşındığını göstermektedir.

Fekal Koliform (FC):

Deniz ortamında mikrobiyolojik kirlenmenin göstergesi olan Fekal Koliform seviyeleri de Mersin körfezine dökülen uç akarsuda ve Mersin şehir kanalizasyonunda bir yıl süre ile izlenmiştir. Akarsularda FC 100 mL' de 150-4000 aralığında sayılmıştır ve genellikle maksimum değerler yaz aylarında elde edilmiştir. Diğer yandan beklendiği üzere Mersin şehir kanalizasyon atıklarında 100 mL'de sayılan FC sayısı çok yüksektir ve

1.7×10^4 ile 1.4×10^9 aralığında deęismektedir.

II.2. MERSİN KÖRFEZİ KIYI SULARININ BİYOKİMYASAL ÖZELLİKLERİ:

Mersin körfezinde belirli istasyonlarda periyodik deniz-saha çalışmaları yapılarak bazı biyokimyasal ve kirletici parametreler ölçülmüştür. 1991-1992 yıllarında 5 kez deniz-saha çalışması yapılmış ve Şekil II.1.' de gösterilen istasyonlarda toplanan su örneklerinde ölçümler yapılmıştır. Şekilden görüleceği üzere bir grup istasyon su anda faaliyette olan Mersin kanalizasyonu bölgesinde, diğer bir grup istasyon ise ileride yapımı planlanan derin deniz desarjı için tasarlanan yer olan Cavuşlu kanalı önünde ve/veya Karaduvar bölgesinde bulunmaktadır. Mersin körfezinde yapılan saha çalışmalarına ait tarihler aşağıda verilmiştir.

5/Aralık/1991 (Kış dönemi)
29/Nisan/1992 (İlkbahar dönemi)
29/May/1992 (İlkbahar dönemi)
18/August/1992 (Yaz dönemi)
2/Ekim/1992 (Sonbahar dönemi)

Bir saha çalışmasında yeterli bilgi edinilememesi nedeniyle ilkbahar döneminde iki saha çalışması yapılmıştır. Bu deniz-saha çalışmalarında elde edilen hidrografik, biyokimyasal ve kirletici parametrelere ait sonuçlar Çizelge II.2., II.3., II.4., II.5. ve II.6.' da verilmiştir.

Biyokimyasal ve Kirletici Parametrelerin Mersin Körfezinde Dağılımı:

pH:

Bu izleme çalışması boyunca Mersin körfezi kıyı sularında pH 8.00 ile 8.36 arasında deęismektedir ve bu deęerler açık su deęerleri ile uyum

icerisinde dir. Bilindiđi üzere deniz suyu çok kuvvetli bir tampondur; bu nedenle karasal kaynaklardan büyük hacimlerde kuvvetli asidik ve/veya bazik atık verilmedikçe deniz suyunun pH' sı etkilenmemektedir. Bölüm II.1.'de tartışıldığı üzere Mersin körfezine desarjı olan akarsular ve kanalizasyon sularının pH' sı kuvvetli asidik ve/veya bazik seviyede değildir ve körfez sularının pH' sını etkilememektedir.

Toplam Asılı Kati (TAK):

Mersin körfezinde ölçülen Toplam Asılı Katının mevsimsel dağılımı Şekil II.2.' de bar grafikler halinde gösterilmiştir. Genelde TAK körfez kıyı sularında 2.6-120 mg/L aralığında ölçülmüştür ve en yüksek değerler Mersin kanalizasyonunun etki alanındaki istasyonlar (M18, M19, M20 ve M24 gibi) ile Karaduvar bölgesinde Cavuşlu kanalının etkisindeki kıyıya yakın istasyonlarda (M1, M2, M3, M4) elde edilmiştir. Bu noktalar dışında ölçülen TAK değerleri 5-20 mg/L arasında değişmektedir ve Kuzeydoğu Akdeniz kıyı sularında ölçülen değerlerle kıyaslanabilir seviyededir. Ancak bilindiđi üzere Akdeniz'in açık sularında TAK konsantrasyonu oldukça düşüktür ve ortalama 2 mg/L seviyesindedir (Berman ve diğ., 1984; Yılmaz ve diğ., 1992b). Mersin körfezinde aynı noktalarda yapılan ve ışık geçirgenliği ve dolayısıyla asılı katının miktarının bir göstergesi olan Secchi disk derinliği ölçümleri 0.5 ile 4 m arasında değişmektedir. Bu değerler açık su değerleri (25-30 m), (Yılmaz et al., 1992b) ile karşılaştırıldığında oldukça düşüktür.

Çözünmüş Oksijen (DO, CO):

Deniz ortamında suda çözünmüş oksijen hemen hemen tüm deniz canlıları için hayati önem taşımaktadır. Örneğin balıklar oksijensiz bir ortamda yaşayamazlar ve mikroorganizmaların ortamda bulunan organik maddeyi parçalamaları (oksitlemeleri) imkansızlaşır. Mersin körfezinde yapılan oşinografik ölçümler çözünmüş oksijen konsantrasyonunun 5.29 ile 11.90 mg/L arasında değiştiđini göstermiştir. Körfezde ölçülen çözünmüş oksijen bulguları mevsimsel bazda Şekil II.3.' de sunulmuştur. Kış ve ilkbaharın ilk

aylarında su kolonunda dÜsey karışımın etkili olması nedeniyle cözÜnmÜs oksijen konsantrasyonu hem yÜzey hem de yÜzey altı sulara bağıl olarak yüksek ölçÜlmÜştür. Özellikle Nisan 1992' de 8 mg/L' nin Üzerinde ölçülen deęerler genelde deniz suyundaki doygunluk deęerlerine ulaismaktadır ve bu yüksek deęerlere atmosferik girdinin yanısıra denizdeki birincil Üretimde olusan oksijen neden olmaktadır. Yaz ve onu takip eden sonbahar mevsiminde su kolonunda sıcaklık farklılaşması nedeniyle tabakalaşma olmaktadır ve bu tabaka bol oksijenli yÜzey sularından dip sulara oksijen taşınmasını engellemektedir. Bu nedenle Cizelgelerdeki bulgulardan görÜleceęi üzere özellikle kanalizasyon desarjı ve akarsuların etki alanındaki istasyonlarda cözÜnmÜs oksijen konsantrasyonu derinlikle azalmaktadır. Yaz aylarında ise yÜzey sularındaki cözÜnmÜs oksijen deęerleri su sıcaklığının yüksek olmasından dolayı oksijenin cözÜnÜrlÜęünün azalması nedeniyle dÜsüktür.

Biyokimyasal Oksijen İhtiyacı (BOI₅):

Mersin körfezi kıyı sularında Biyokimyasal Oksijen İhtiyacı genelde 5 mg/L' nin altında ölçÜlmÜştür ve ölçüm aralığı <0.1 mg/L ile 10.3 mg/L arasında deęismektedir. En dÜsük BOİ deęerleri Aralık 1991 döneminde, en yüksek deęerler ise genelde biyolojik olarak parçalanabilir organik maddenin en fazla olduęu yaz aylarında -Aęustos 1992' de- ölçÜlmÜştür. Beklendięi üzere en yüksek deęerler Mersin şehir desarjının etkisi altındaki M18, M19, M20, M23, M24 istasyonları ile yine karasal girdilerin etkisi altındaki ve Karaduvar bölgesinde yer alan M1, M2, M3 ve M4 istasyonlarında ölçÜlmÜştür.

Kimyasal Oksijen İhtiyacı (KOİ):

Aralık 1991-Ekim 1992 tarihleri arasında Mersin körfezi kıyı sularında ölçülen Kimyasal Oksijen İhtiyacı bulguları mevsimsel bazda Sekil II.5.' de sunulmuştur. 23.9 mg- $\frac{O}{L}$ ' ye varan yüksek KOİ deęerlerinin elde edildięi Mersin körfezinde genellikle karasal kaynakların (özellikle şehir kanalizasyonunun) etki alanındaki istasyonlarda (M18, M19 ve M20) KOİ deęerleri yüksektir. 0.52 mg/L gibi minimum KOİ deęerleri ise genelde kıyı

etkisinden uzak istasyonlarda ölçülmüştür.

Inorganik Fosfat (O-PO₄):

Mersin körfezi kıyı sularında ölçülen çözünmüş inorganik fosfatın mevsimsel dağılımı Şekil II.6.' da sunulmuştur. Genellikle evsel atıkların etkisindeki istasyonlarda (M18-M30), fosfat değerleri bütün yıl boyunca bağlı olarak yüksektir. Çavuşlu kanalının etki alanındaki istasyonlarda da konsantrasyon seviyeleri açık sularinkine oranla oldukça yüksektir. Mersin körfezi kıyı sularında inorganik fosfat 0.02 µM ile 20.32 µM aralığında ölçülmüştür. Bilindiği üzere Doğu Akdeniz suları besin tuzlarınınca (Fosfat ve nitrat) çok fakirdir ve özellikle açık sularda üretken yüzey tabakasında inorganik fosfat 0.02-0.03 µM gibi ölçüm limitlerine düşmektedir. Doğu Akdeniz' de fosfat biricil üretimi sınırlandıran besin tuzu olarak belirlenmiştir (Krom, ve diğ. 1991).

Toplam Oksitlenmiş Azot (NO₃ + NO₂):

Bölüm II.1' de bahsedildiği gibi kıyısız alanlarda yüzey sularının besin tuzu ihtiyacı karasal kaynaklar (genelde akarsular) ve kısmen de deniz ortamındaki rejenerasyon proseslerinden sağlanmaktadır. Şekil II.7' de Aralık 1991-Ekim 1992 tarihleri arasında Mersin körfezinde ölçülen toplam oksitlenmiş azot değerleri verilmiştir. Bağlı olarak en yüksek NO₃ + NO₂ konsantrasyonları Karaduvar bölgesinde Çavuşlu kanalının etkisindeki istasyonlarda ölçülmüştür. Mersin şehir kanalizasyonunun etkisi altındaki istasyonlarda da bağlı olarak yüksek değerler elde edilmiştir ancak Bölüm II.1.' de söz edildiği gibi Mersin şehir desarjından bağlı olarak düşük seviyede azot girdisi olduğundan bu bölgede deniz suyundaki toplam oksitlenmiş azot değerleri Karaduvar bölgesindeki değerlerden daha düşüktür. Cizelgeler II.2.-II.6' dan görüleceği üzere Mersin körfezi kıyı sularında toplam oksitlenmiş azot konsantrasyonu 0.07-36.20 µM aralığında ölçülmüştür.

Fekal Koliform (FC):

Mersin körfezi kıyı sularında mevsimsel bazda ölçülen Fekal Koliform analizleri bu körfezin çok fazla evsel atığa maruz kalması nedeniyle mikrobiyolojik açıdan kirlenmiş durumda olduğunu göstermektedir. Sekil II.8. seçilmiş istasyonlarda ölçülen Fekal koliform bakteri sayılarının mevsimsel dağılımını vermektedir. Dünya Sağlık Teskilatı'nın (WHO), yüzme veya genel olarak yakın kıyı suları için verdiği limit 100 mL' de 100 adettir ve bu limit Su Kirliliği Kontrolü Yönetmeliğinde yüksek tutulmuştur ve zaman zaman değişikliklere uğramıştır (Su Ürünleri Tüzüğü). Fekal Koliform Mersin körfezi kıyı sularında 100 mL de <10 gibi çok düşük değerler ile 3.000.000 kadar büyük değerler arasında değişmektedir. En yüksek değerler Mersin şehir desarjına en yakın istasyonlarda ölçülmüştür. Nadiren WHO limitini aşan değerler Karaduvar bölgesinde de ölçülmüştür ve karasal kaynaklı mikrobiyolojik kirlenmeyi göstermektedir.

II.3. T-90 DENEYİ VE RODAMİN-B BOYA İZLEME ÇALIŞMASI

Mersin körfezinde evsel atıktan kaynaklanan Fekal Koliformların kaynaktan çıktıktan sonra % 90' nının ölmesi için gerekli zaman olarak bilinen T-90 ölçümleri ve kanalizasyon atıklarının anında izlenmesini sağlayan Rodamin-B boya çalışması Ekim 1992 tarihinde yapılmıştır. Bu çalışmada, 2 kg boyanın % 40 lık asetik asit içerisindeki Rodamin-B çözeltisi (5 L) Mersin kanalizasyon desarjının denize döküldüğü noktada yüzeye ani olarak boşaltılmıştır. Daha sonra Rodamin boyası sadece bu boyaya hassas ölçümler yapabilen in situ florometre ile görsel olarak seçilmiş istasyonlarda izlenmiştir. Rodamin-B boya izlemesine ait sonuçlar Sekil II.9.' da verilmiştir. Boya çalışmasının yapıldığı istasyonların koordinatları Decca Trisponder Navigasyon sistemi kullanılarak anında saptanmıştır. Sekil II.9a.' dan görüleceği üzere iki istasyon arasındaki zaman farkı 4-19 dakika arasında değişmektedir. Her istasyonda yerinde yapılan floresans ölçümlerine paralel olarak farklı derinliklerden su örnekleri toplanmış ve bu örneklerde anında Fekal Koliform analizleri yapılmıştır. Ayrıca su örnekleri Enstitü laboratuvarlarına taşınarak laboratuvar tipi

Spektroflorometre ile de Rodamine-B konsantrasyonları saptanmış ve in situ florometre sonuçları kalibre edilmiştir. Rodamin-B boya çalışmasında elde edilen konsantrasyon değerleri Sekil II.9b' de harita üzerinde gösterilmiştir. Bu boya körfezde ancak iki buçuk saat süre ile takip edilebilmiştir ve bu süre sonunda boyanın deniz suyundaki konsantrasyon seviyesi florometrik olarak takip edilemez seviyeye düşmüştür. Sekil II.9b.' den görüleceği üzere boya denize boşaltıldıktan sonra iki kola ayrılmıştır ve ilk olarak doğuya doğru yönelen boya izlenmiştir. İkinci ve birinciye oranla daha zayıf olan ikinci kol önce batıya sonra kuzeybatıya doğru yönelmiştir. Boya izleme çalışması desarjin batısında R8 istasyonunda, doğusunda R7, R10, R14 ve R15 istasyonlarında seyrelme faktörü 10^4 oluncaya kadar sürdürülmüştür. Anında yapılan Fekal Koliform ölçümleri de yaklaşık aynı seyrelme faktörü ile benzer dağılımı göstermiştir ve bu sonuçlar Sekil II.9c.' de harita üzerinde sunulmuştur.

Ekim 1992 deniz-saha çalışmaları çevresel koşullarında yapılan ve bölge Fekal Koliformunu karakterize edecek olan T-90 testinde, Fekal koliformların boyanın seyrelme eğilimine paralel olarak dağıldığını göstermiştir. Ancak bu çalışmada elde edilen korelasyon, boyanın boyasız deniz suyu ile karışımının boya konsantrasyonunu etkilemesi ile değişik sayıda Fekal Koliform içeren suların karışımının Fekal Koliform sayılarını aynı şekilde etkilememesi ve Fekal Koliformların zamanla parçalanarak sayıca azalması nedeniyle tam anlamıyla yeterli değildir. Bu nedenle desarjin doğusunda Fekal Koliform değerlerinde dalgalanmalar görülmektedir. Sonuç olarak bu deney sırasında elde edilen bulgulara dayanılarak T-90 değerinin (Ekim ayı için) 1-2 saat aralığında olduğu hesaplanmıştır.

Bölüm II.2.' de tartışıldığı ve Sekil II.10.' da gösterildiği gibi Mersin körfezinde Fekal koliformun dağılımını özellikle kanalizasyon atıklarından ve akarsulardan girdiler ile deniz ortamındaki fiziksel ve biyokimyasal prosesler etkilemektedir. T-90 değeri, Fekal Koliform ve körfezdeki akıntı değerleri kullanılarak indirek olarak tekrar hesaplanmıştır. Eğer körfezde akıntının ortalama 20-50 cm/sn olduğu varsayılırsa (Bölüm I.), ve genelde Fekal Koliform sayıları kanalizasyon desarjından hemen hemen 500-1000 m uzaklıktaki noktalarda sifıra yaklaşıyorsa T-90 değerinin körfezde >1 saat ile <1.5 saat arasında olması gerekmektedir ve yapılan hesaplarda da bu sonuç elde edilmiştir.

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APPENDIKS A

Sembol	Birim	Acıklama
T	$^{\circ}\text{C}$	Sıcaklık
S	$^{\circ}/\text{oo}, \text{ppt}, \text{psu}$	Tuzluluk
SD	m	Secchi Disk Derinligi
pH	-	Asitlik-Bazlık
TSS	mg/L	Toplam Asılı Katı
DO	mg/L	Cozunmus Oksijen
BOD ₅	mg/L	Biyokimyasal Oksijen İhtiyacı (5 gunluk)
COD [*]	mg/L	Kimyasal Oksijen İhtiyacı
o-PO ₄ -P	μM	Orto-fosfat
NO ₃ +NO ₂ -N	μM	Toplam Oksitlenmis Azot (Nitrat + Nitrit)
FC	#/100mL	Fekal Koliform
Tot-P	μM	Toplam Fosfor (Organik + Inorganik)

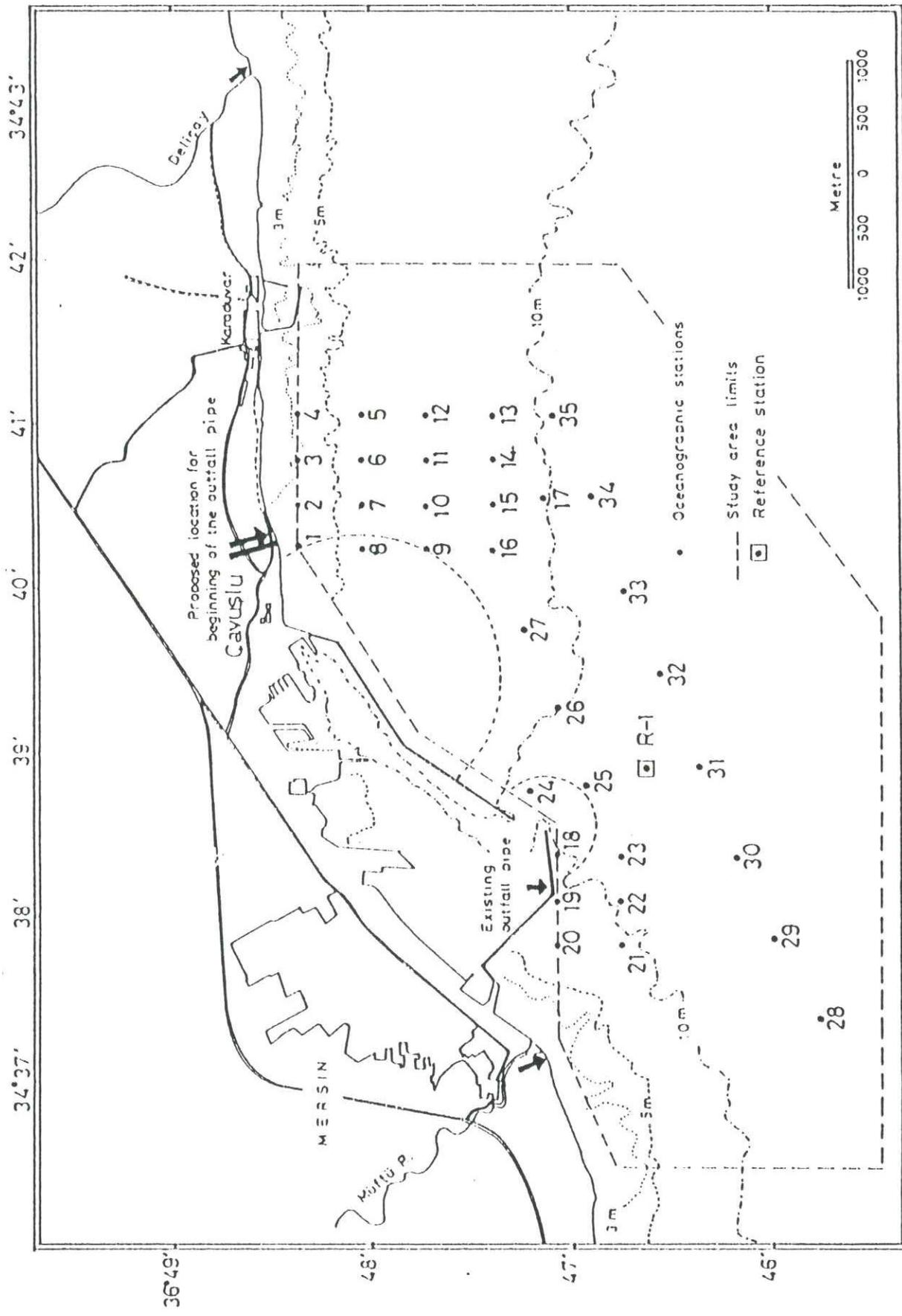
PAH	$\mu\text{g/L}$	Poliaromatik Petrol Hidrokarbonları
Hg	ng/L	Suda Toplam Civa
Cd	ng/L	Suda Toplam Kadmiyum
Cd_{TSS}	ng/L	Asılı Katıda Kadmiyum

* Deniz suyunda COD asılı katıda ölçülmüştür. Bunun nedeni deniz suyundaki klorun bu deney sırasında reaksiyonları etkilemesidir.

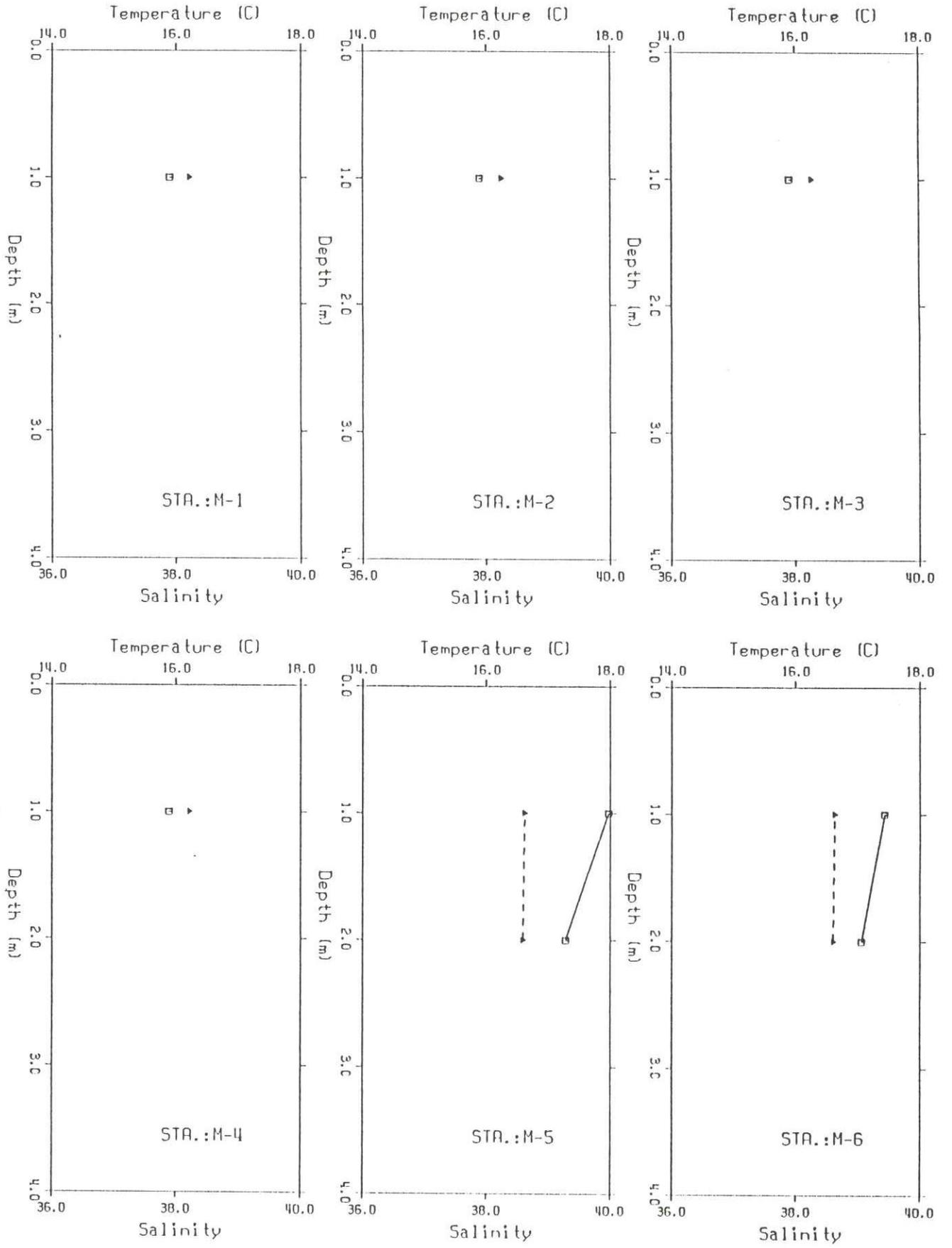
APPENDIKS B

METODLAR:

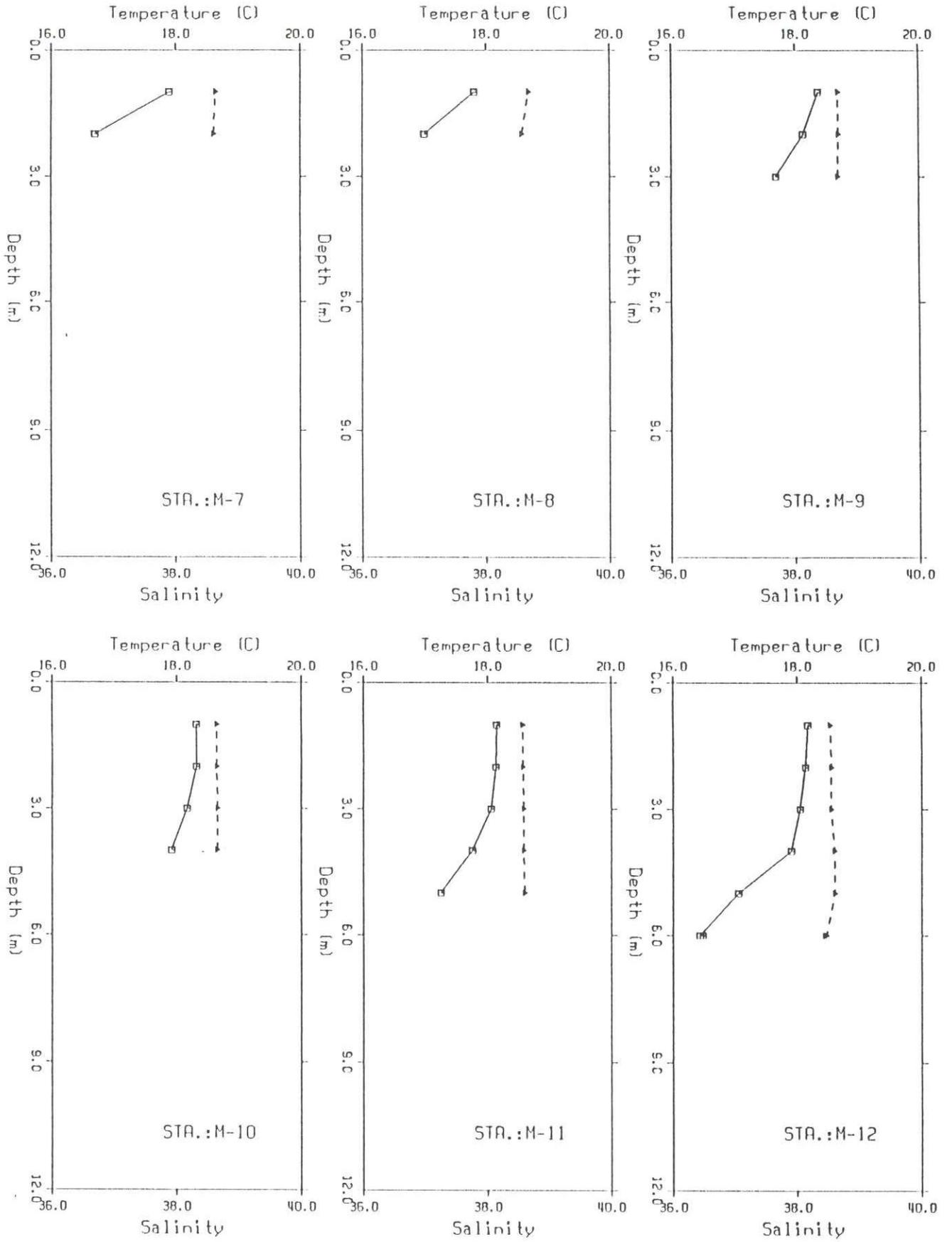
Parametre	Sembol	Metod	Duyarlilik Sınırı	Referans
Dissolved Oxygen	DO	Winkler Titration	3µM	Strickland and Parsons, 1972
Total Suspended Sediment	TSS	Gravimetric	0.1 mg	APHTA, AWWA, WPCF Standard Methods 1980
o-Phosphate	PO4-P	Phospho-molybdate complex formation Autoanalyzer	0.02 µM	Strickland and Parsons 1972 Grasshoff, 1976
Nitrate+ Nitrite	NO ₃ +NO ₂	Cd-Cu reduction Azo-dye formation Autoanalyzer	0.05 µM	Strickland and Parsons 1972 Grasshoff, 1976
Faecal Coliform	FC	Membrane Filtration	93%	APHA, AWWA, WPCF 1980
Biochemical Oxygen Demand	BOD ₅	Incubation at 20°C/5days Winkler Titration or DO probe	0.1 mg/L	Strickland and Parsons, 1972
Chemical Oxygen Demand	COD	Oxidation with K ₂ Cr ₂ O ₇ /H ₂ SO ₄ Titrimetric	0.1 mg/L	APHA, AWWA, WPCF 1980
Petroleum Hydrocarbons	DDPH (PAH)	n-hexane extraction Fluorometric	0.01µg/L	UNESCO, 1984 UNEP, 1986
Mercury	Hg(water)	Cold vapor, AAS	0.25ng	Yemeniciloglu, 1980
Cadmium	Cd(water)	Aqua Regia digestion Flameless AAS	0.02ng	Ediger et al., 1974
	Cd(sed)	Hot NO ₃ digestion	0.02ng	"
Total Phosphorus	T-P	Persulphate oxidation, phospho molybdate complex formation Spectrophotometry or Autoanalyzer	0.1µM	Strickland and Parsons, 1972; FAO Fisheries Tech.Rep. No:137, 1975



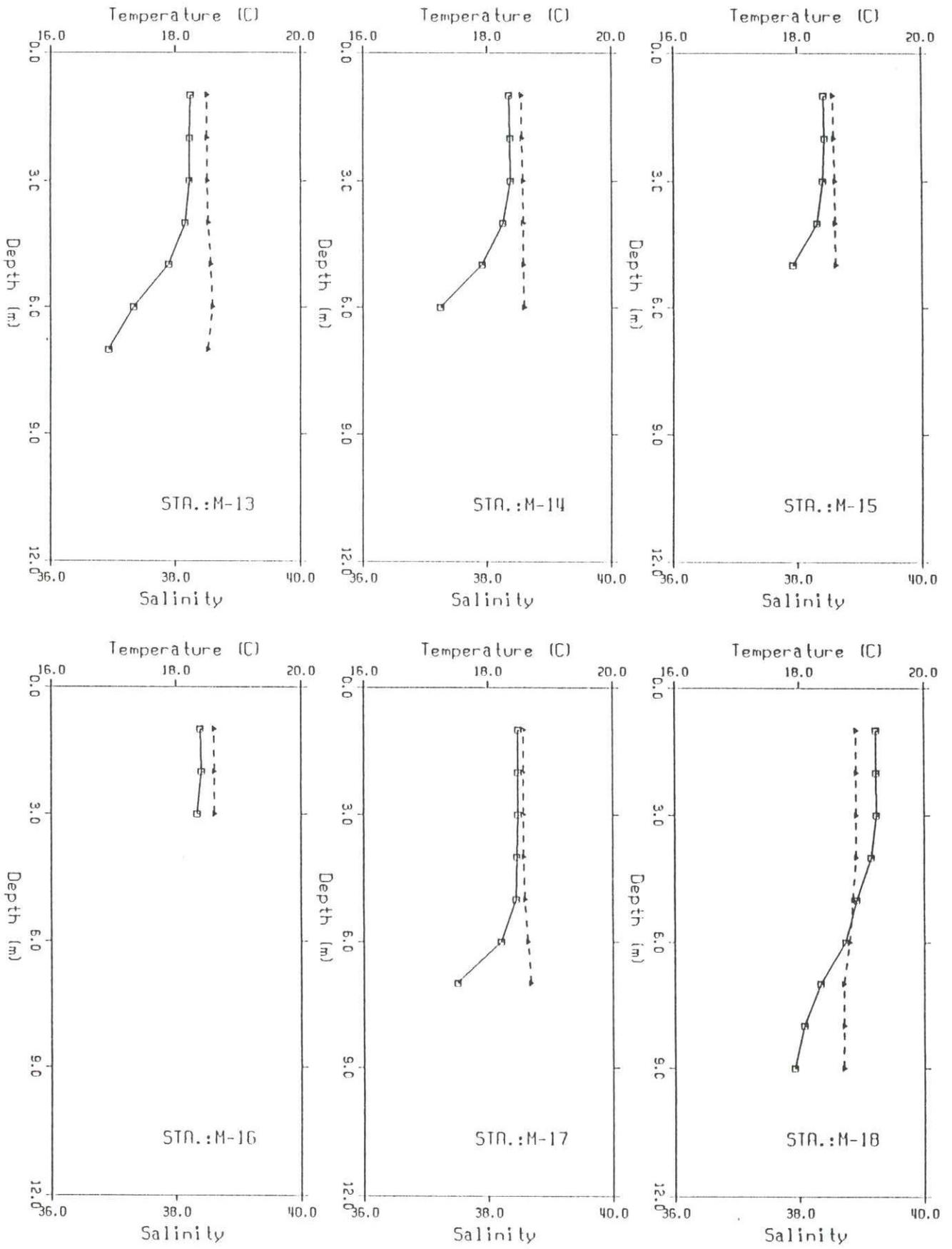
SEKİL. I.1 İstasyon mevkilere



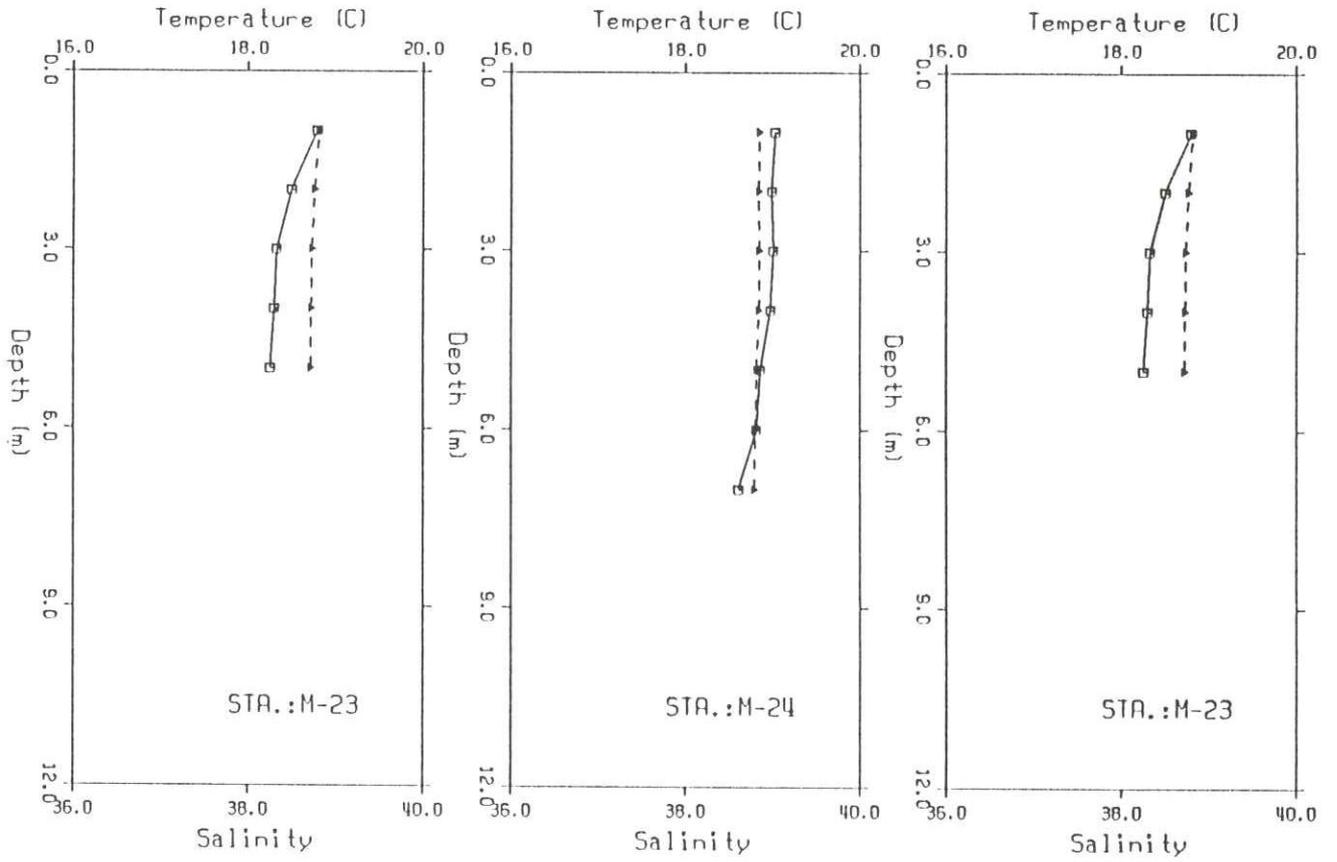
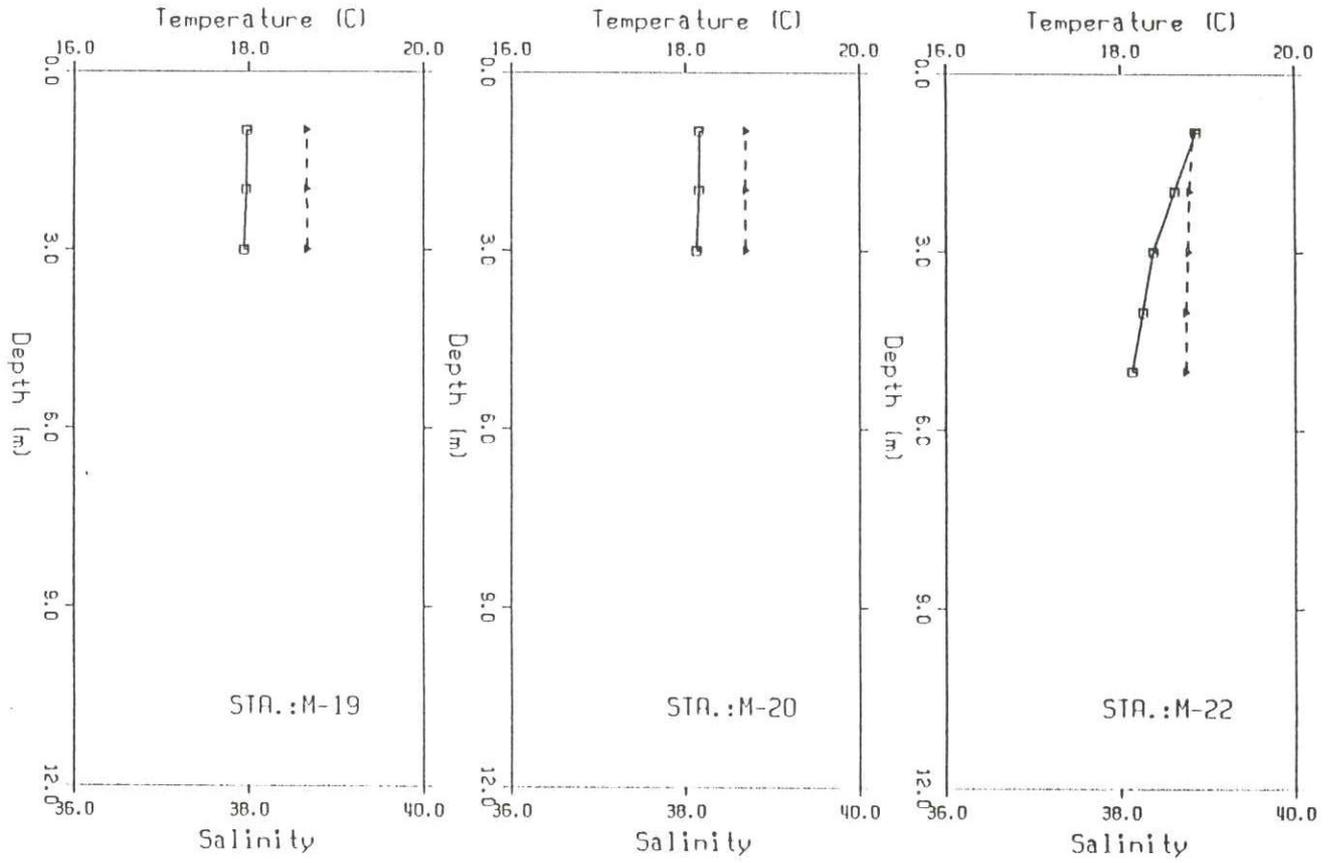
SEKİL. I.2 Aralık 91 Tuzluluk ve Sıcaklık profilleri



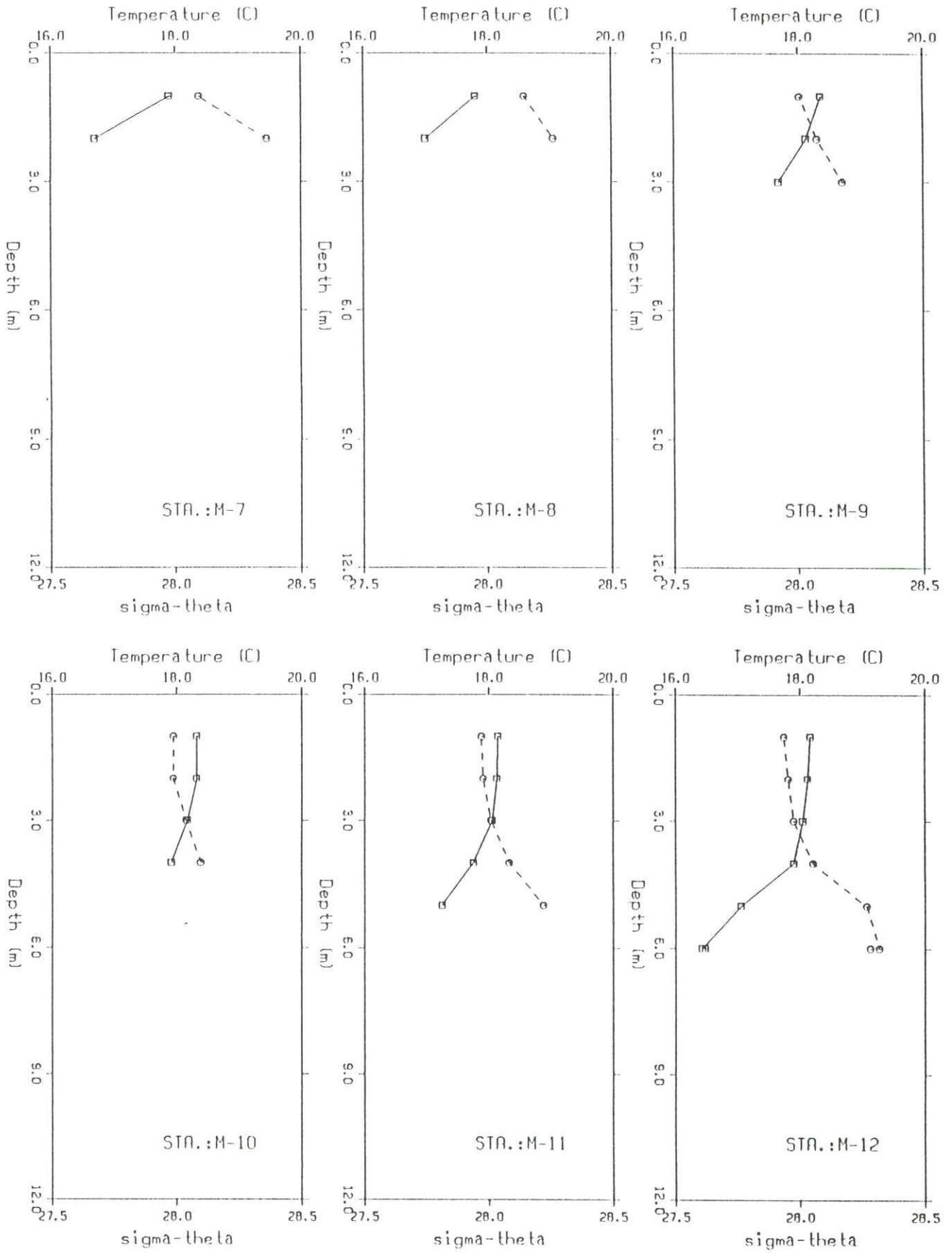
SEKİL.I.2 Aralık 91 Tuzluluk ve Sıcaklık profilleri



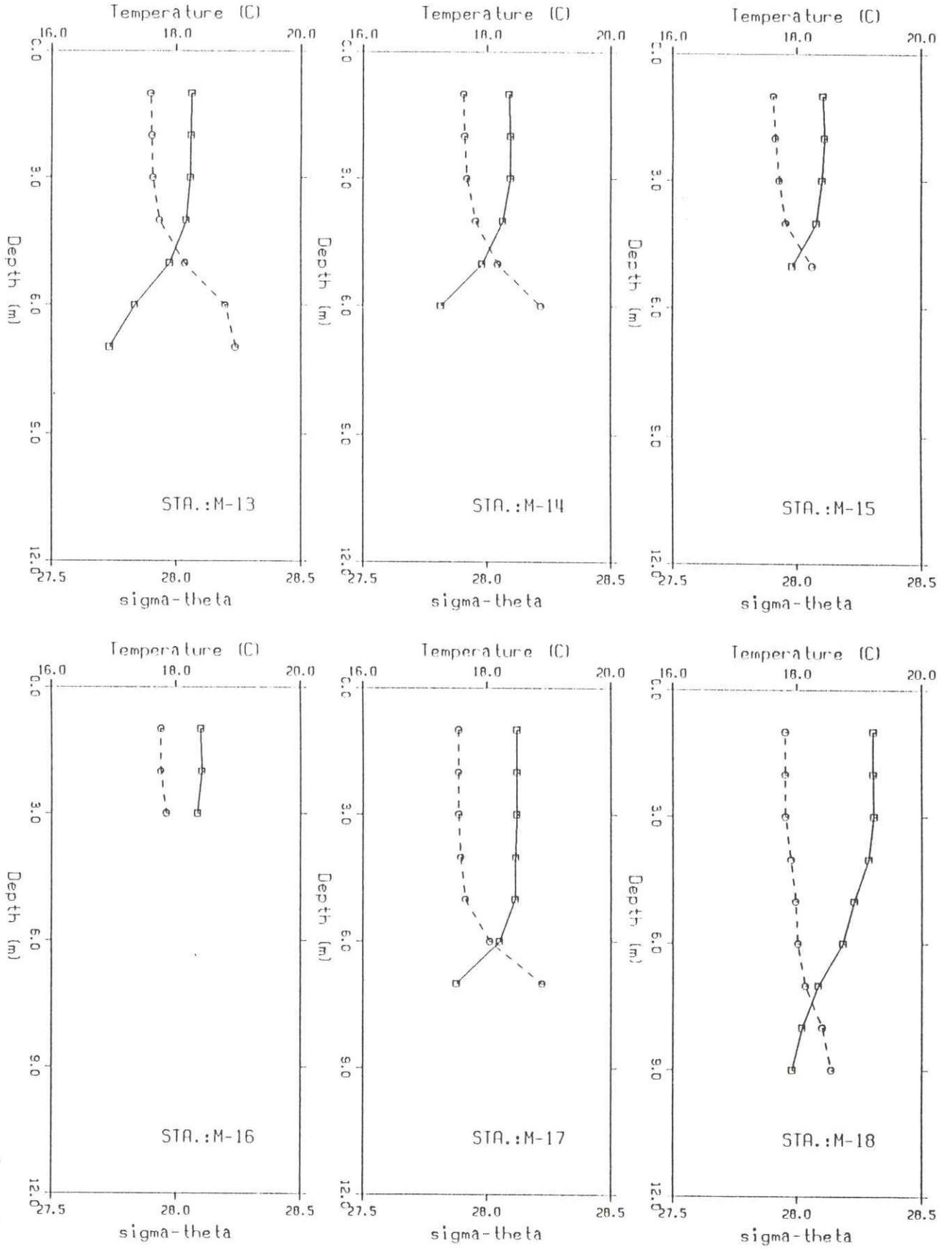
ŞEKİL. I.2 Aralık 91 Tuzluluk ve Sıcaklık profilleri



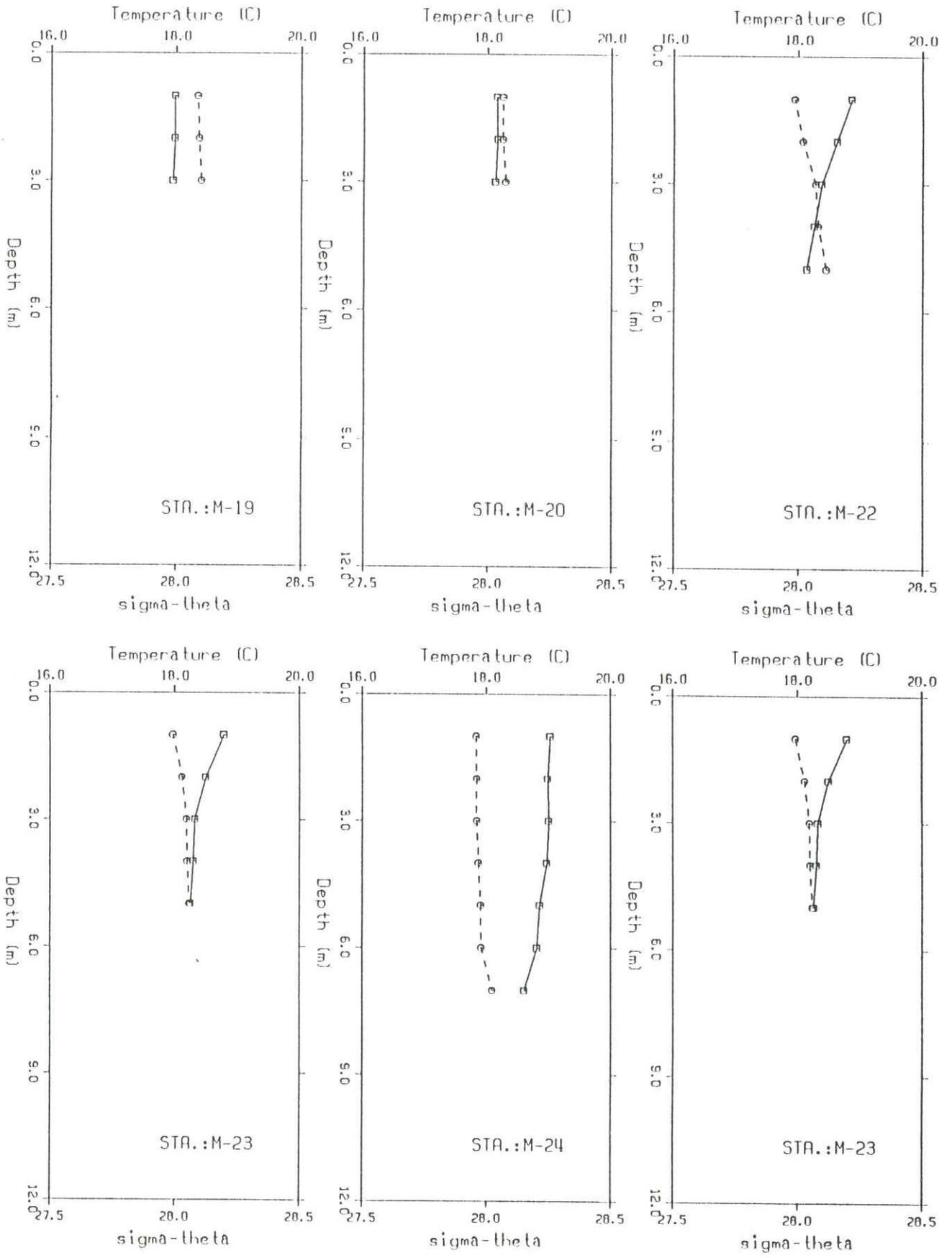
SEKİL. I.2 Aralık 91 Tuzluluk ve Sıcaklık profilleri



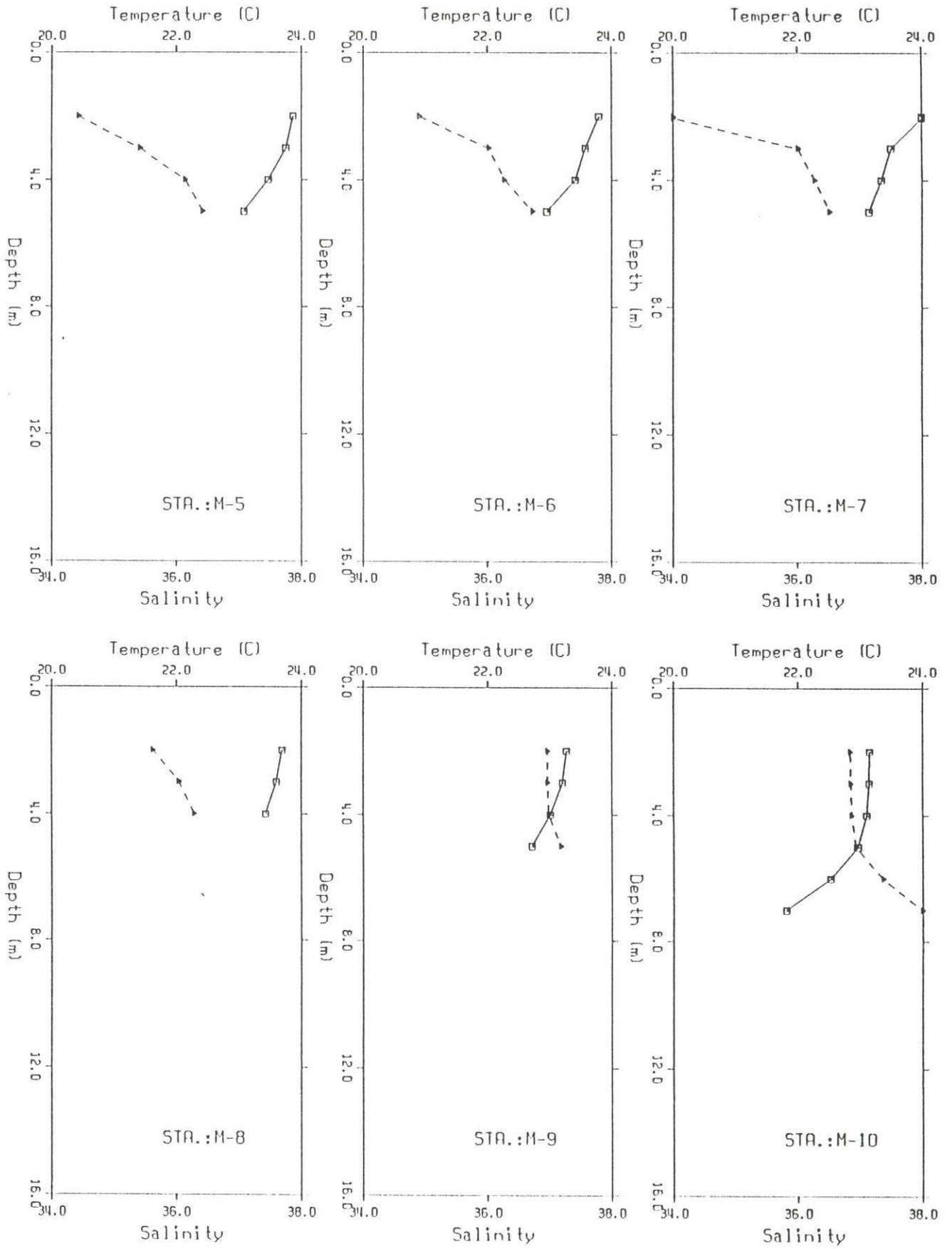
SEKİL. I.2 Aralık 91 Sıcaklık ve Yoğunluk profilleri



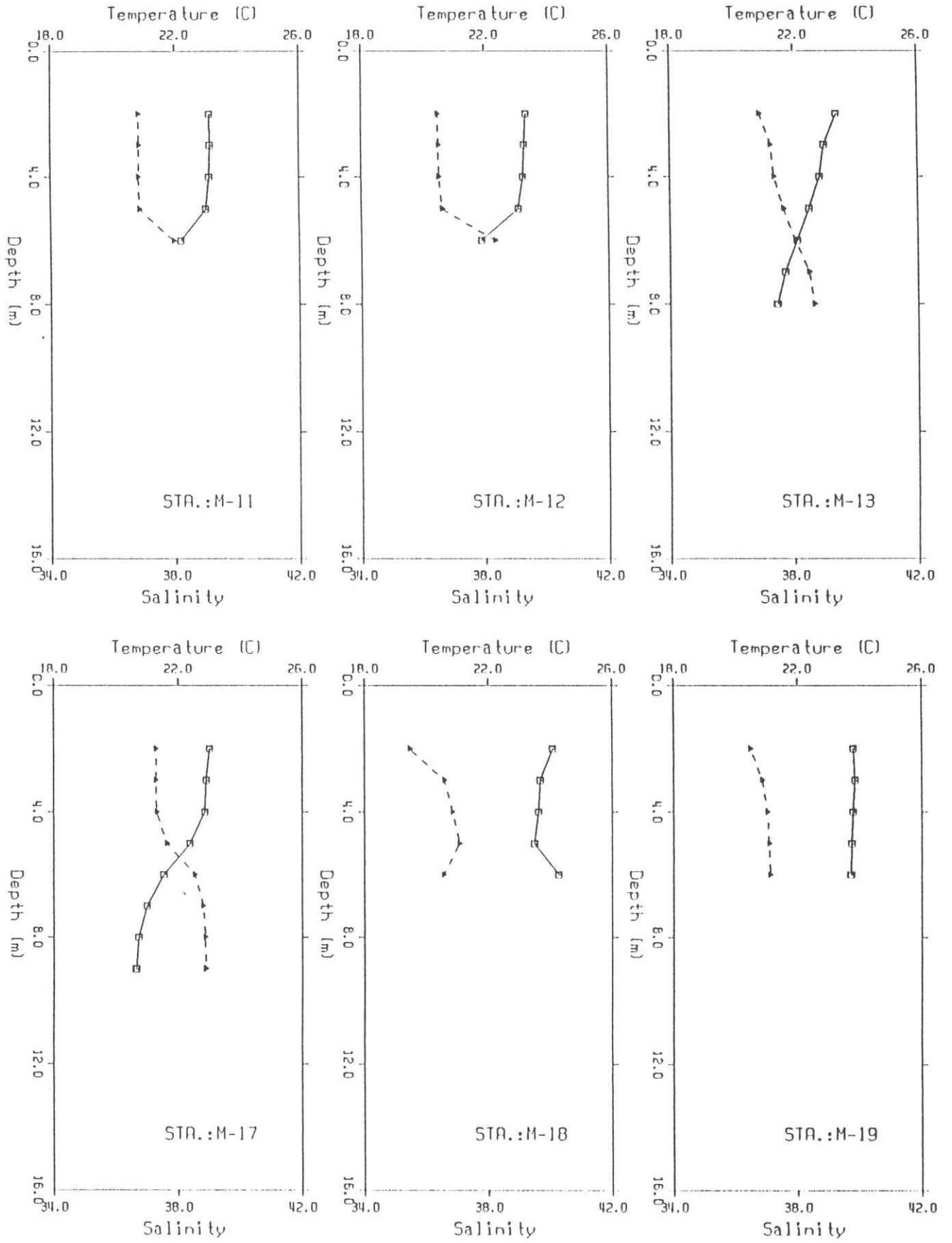
SEKİL. I.2 Aralık 91 Sıcaklık ve Yoğunluk profilleri



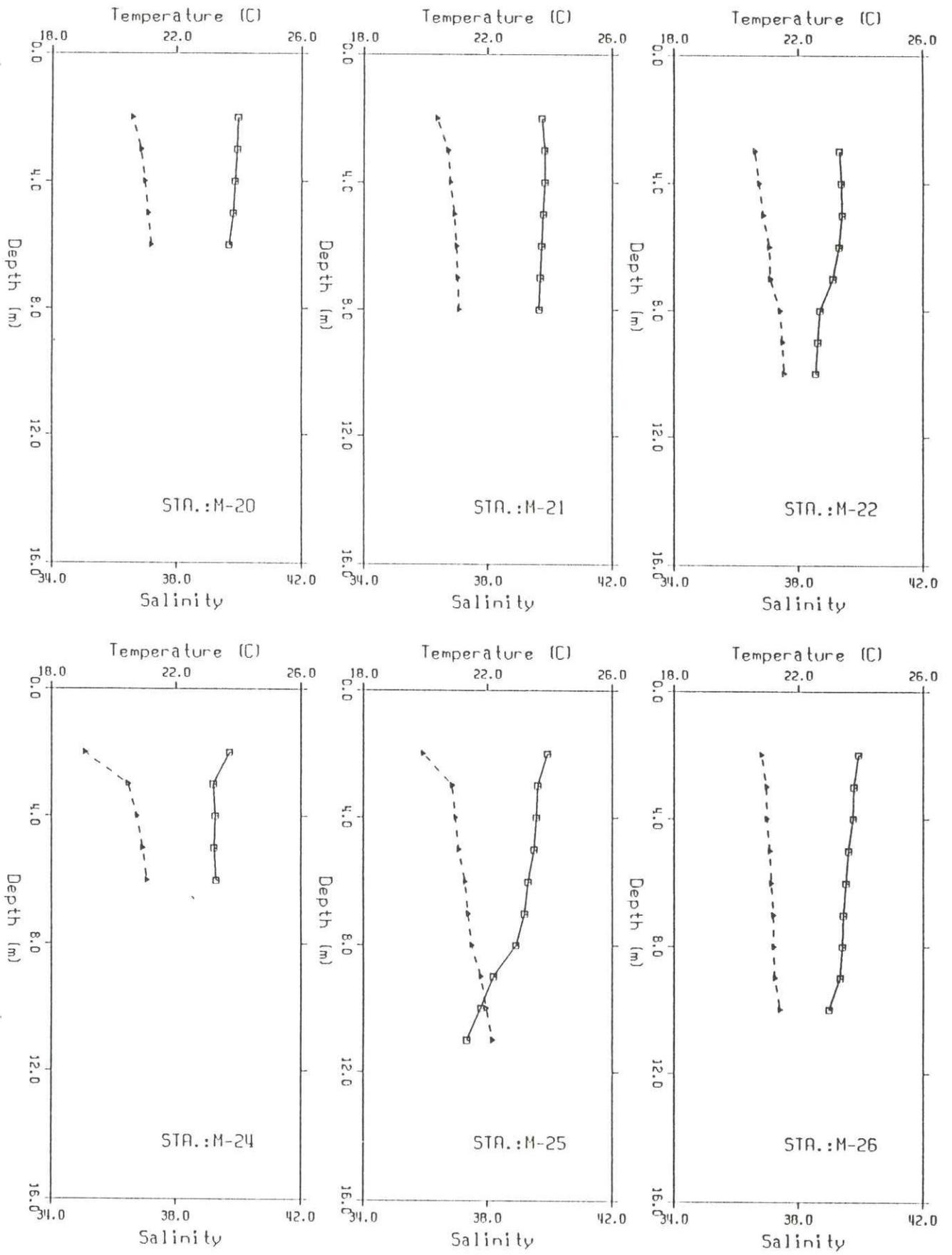
SEKİL. I.2 Aralık 91 Sıcaklık ve Yoğunluk profilleri



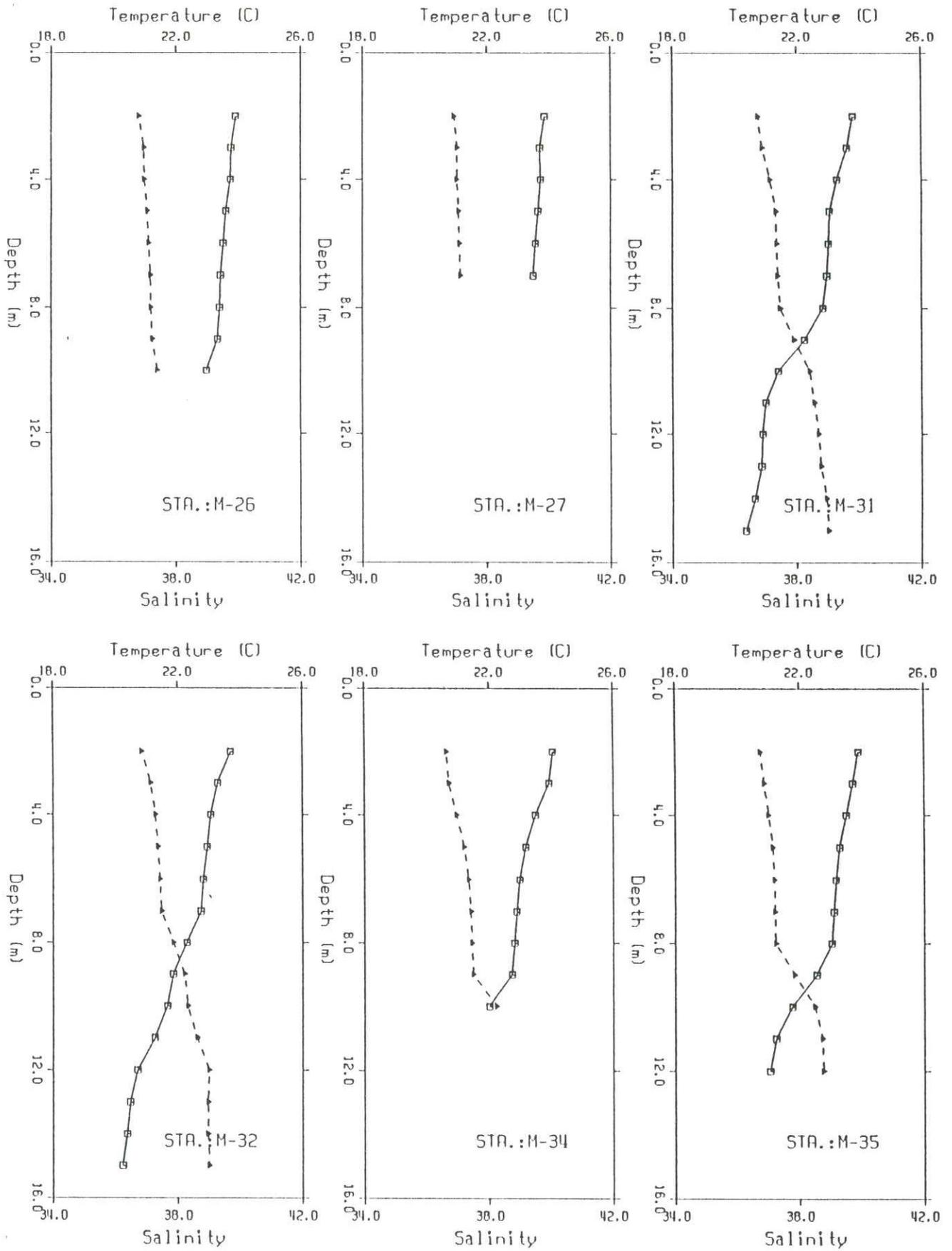
SEKİL. I.3 Mayıs 1992 Tuzluluk ve Sıcaklık profilleri



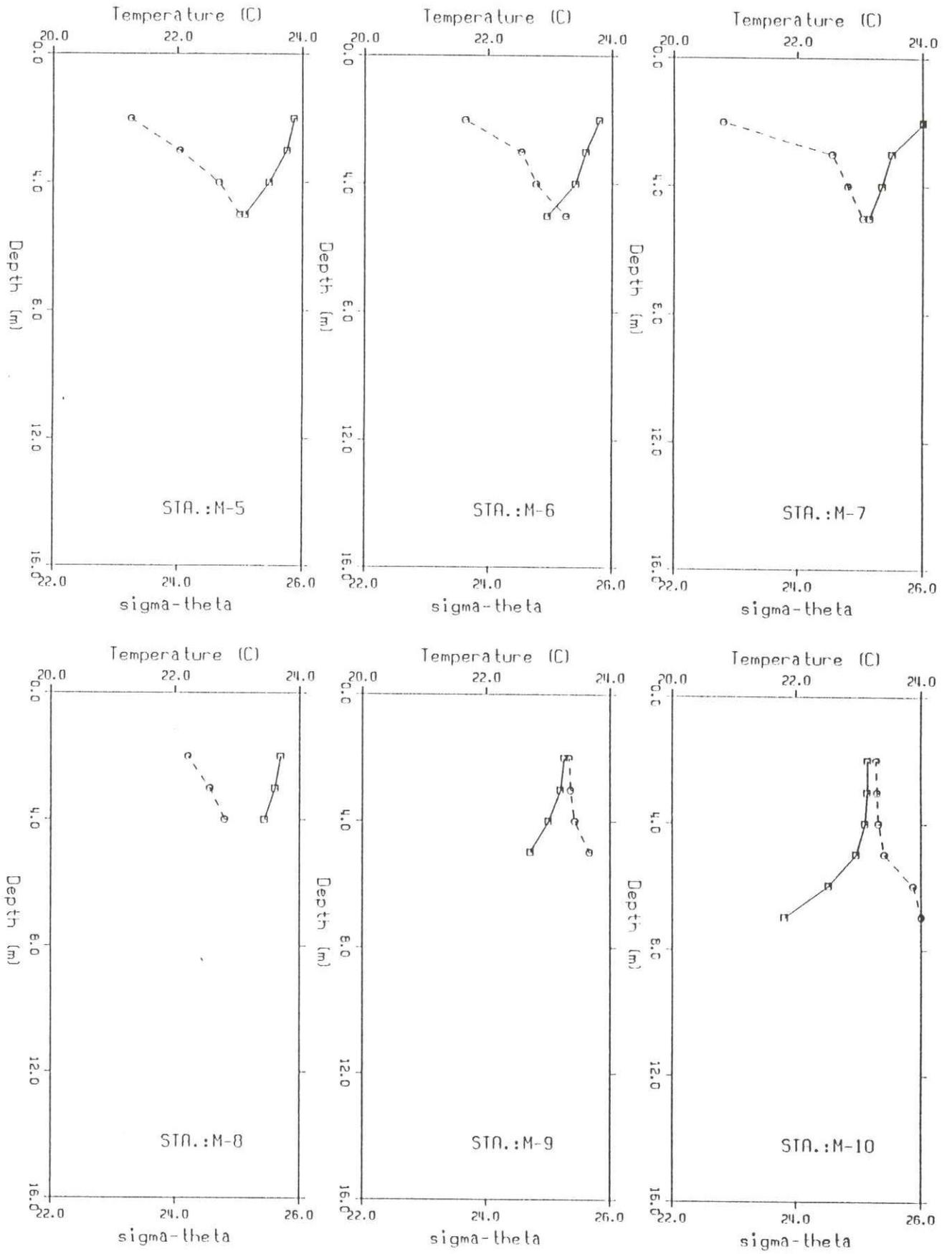
SEKİL. I. 3 Mayıs 1992 Tuzluluk ve Sıcaklık profilleri



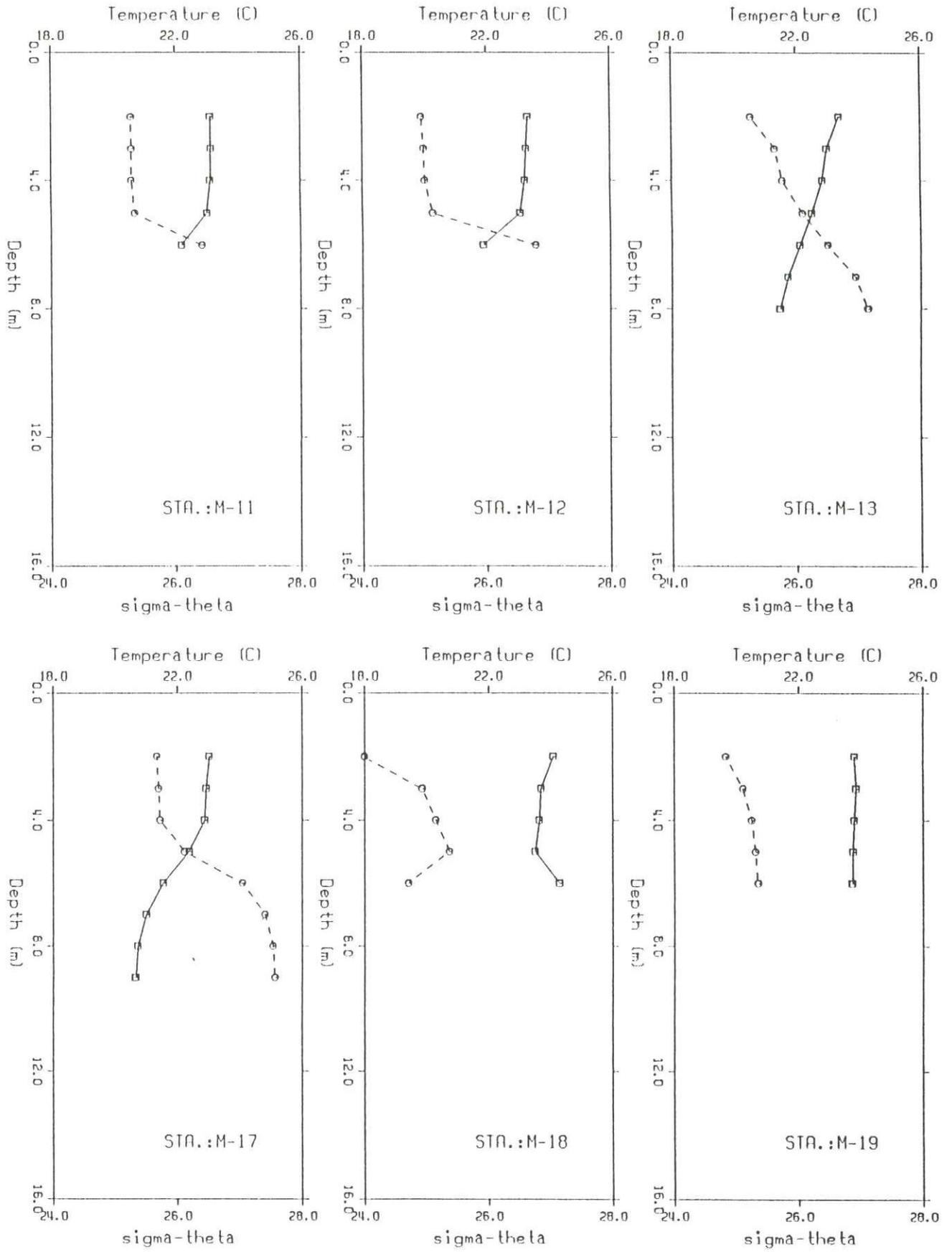
SEKİL. I.3 Mayıs 1992 Tuzluluk ve Sıcaklık profilleri



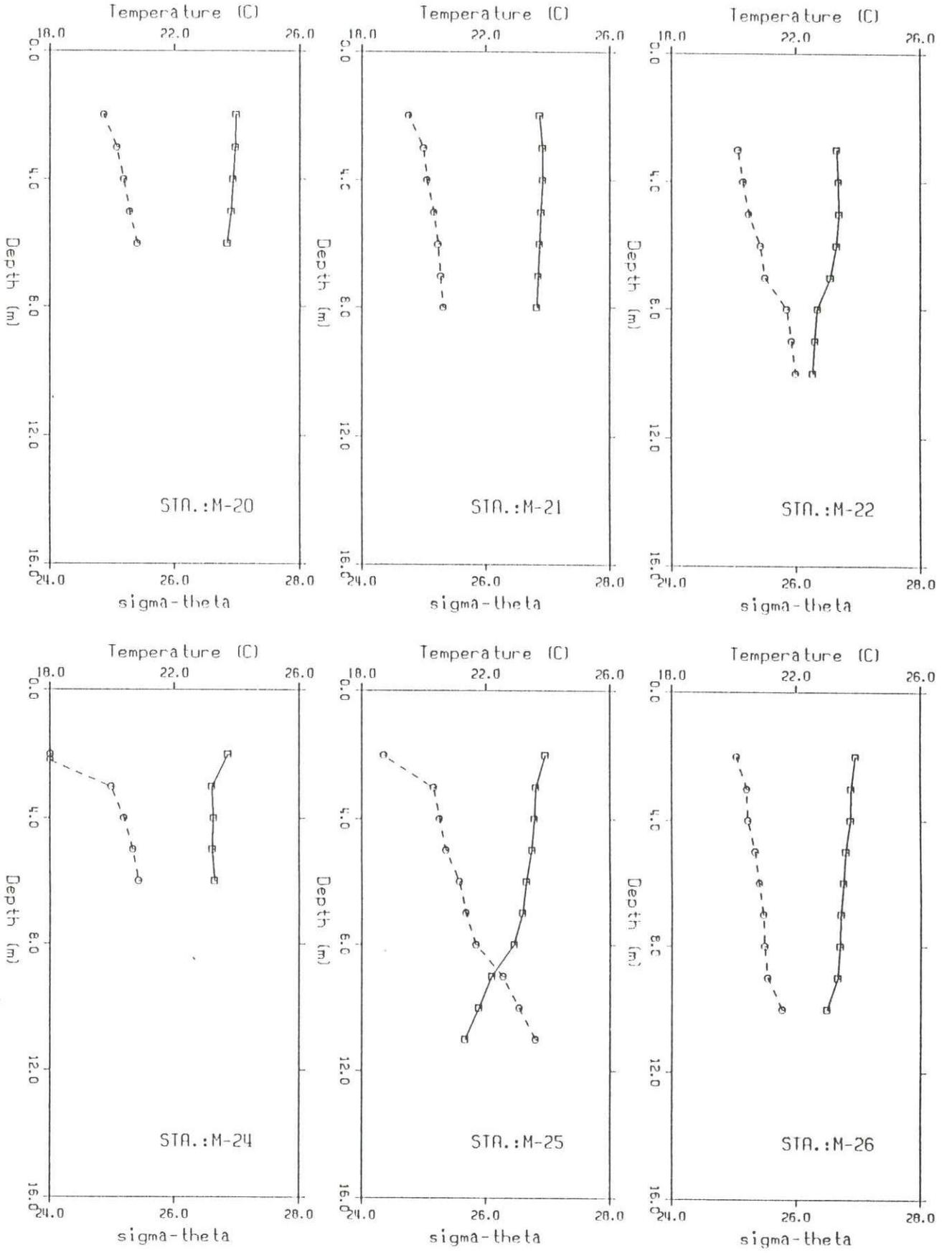
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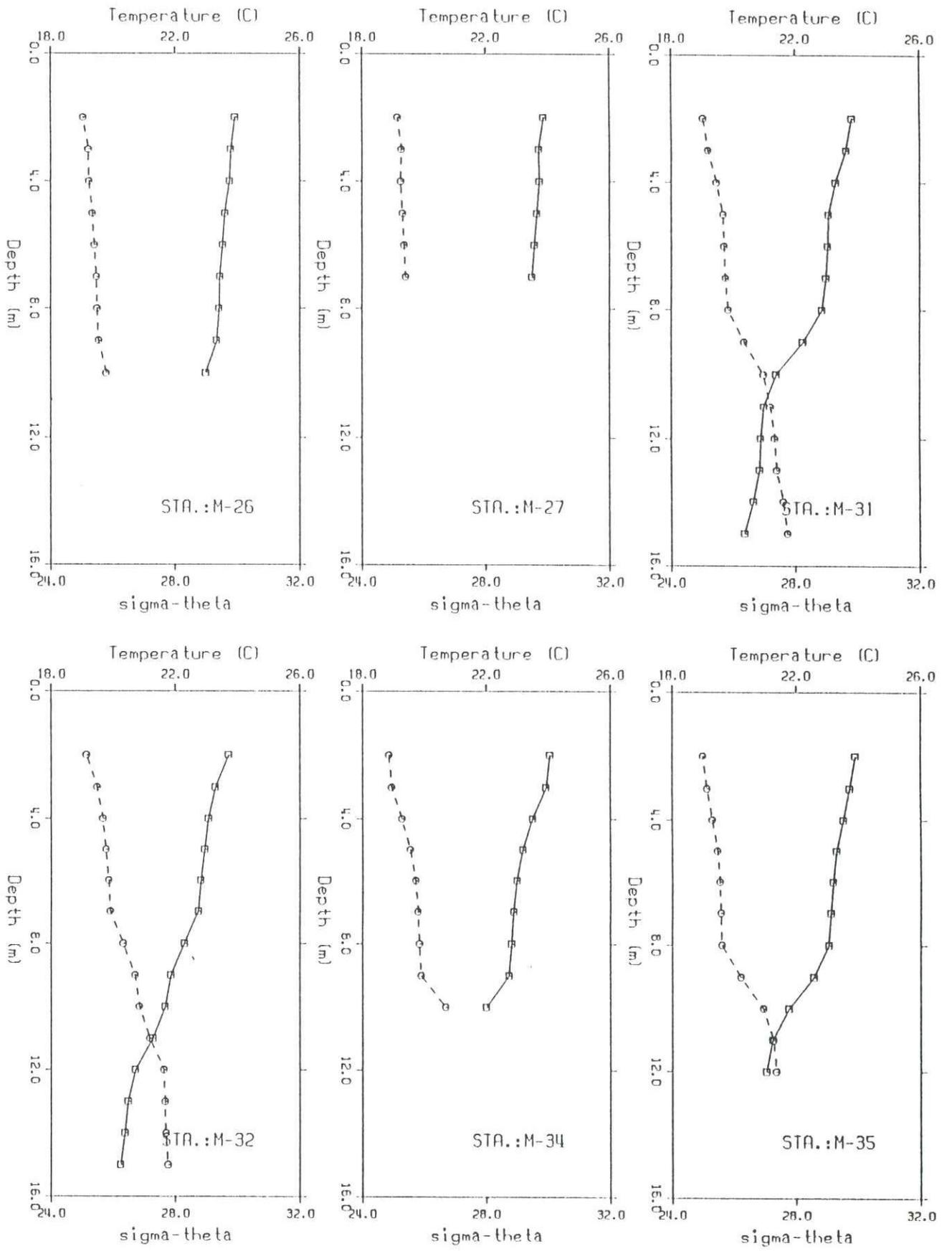
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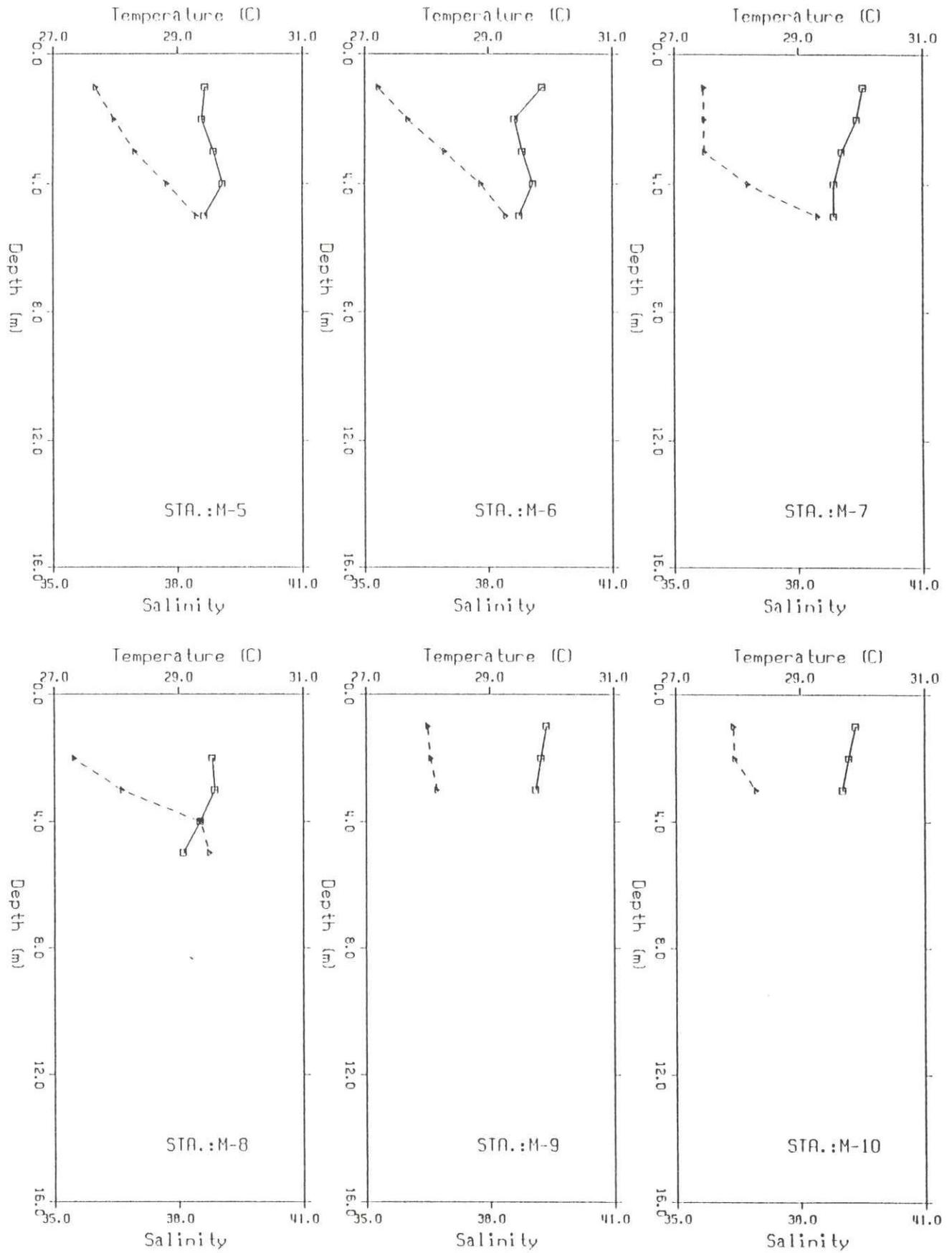
SEKİL. I.3 Mayıs 1992 Sıcaklık ve Yoğunluk profilleri



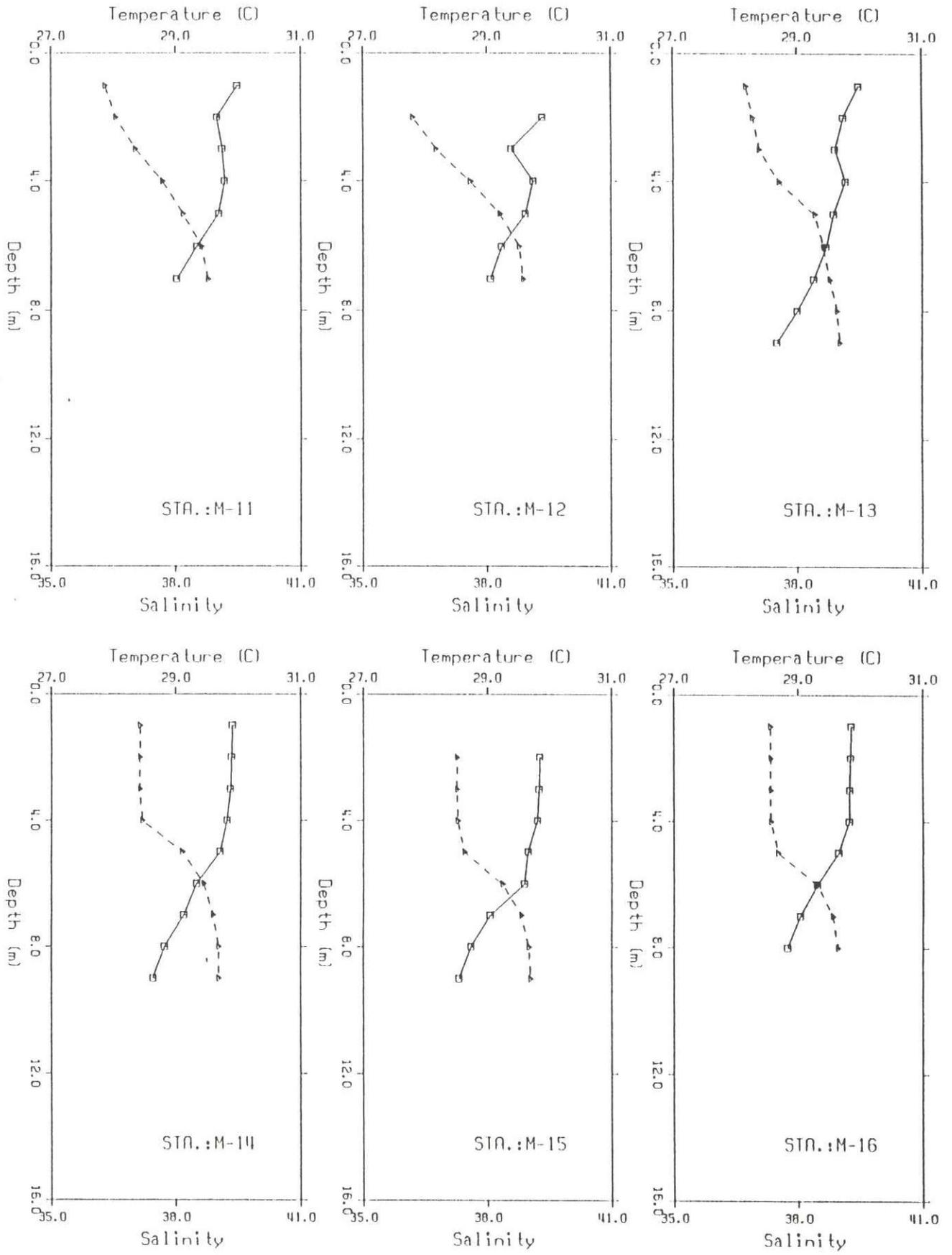
SEKİL. I.3 Mayıs 1992 Sıcaklık ve Yoğunluk profilleri



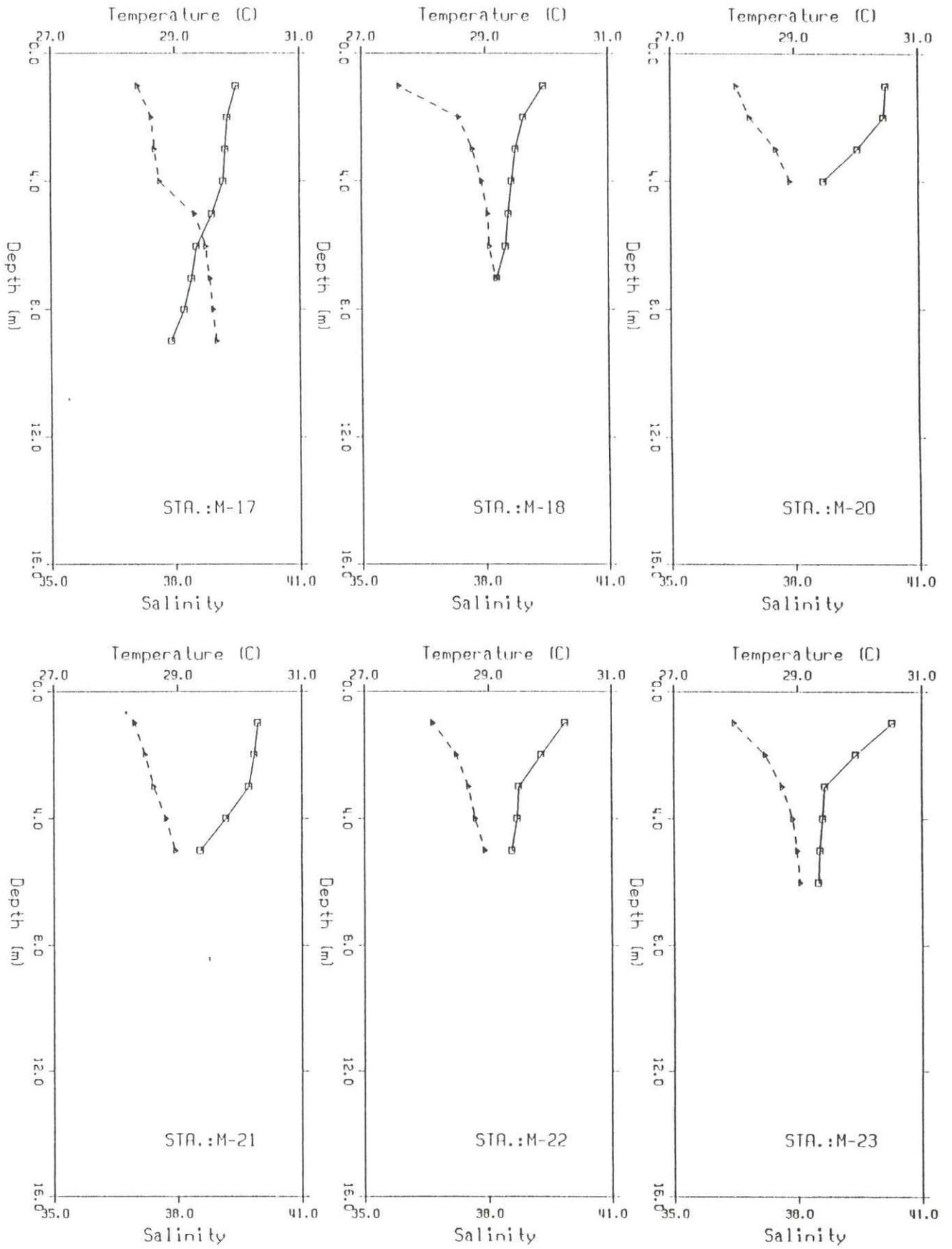
SEKİL. I.3 Mayıs 1992 Sıcaklık ve Yoğunluk profilleri



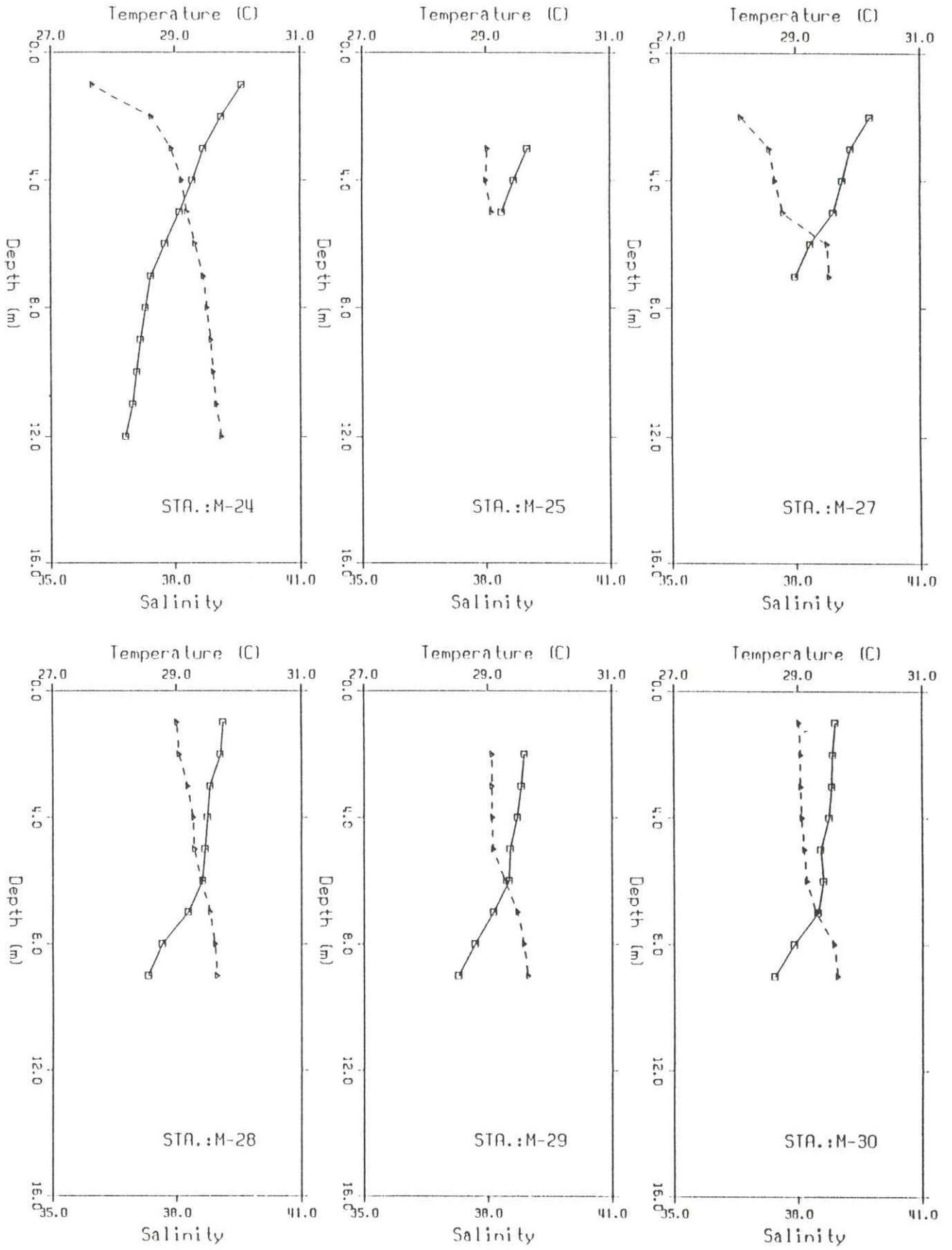
SEKİL.I.4 Ağustos 1992 tuzluluk ve Sıcaklık profilleri



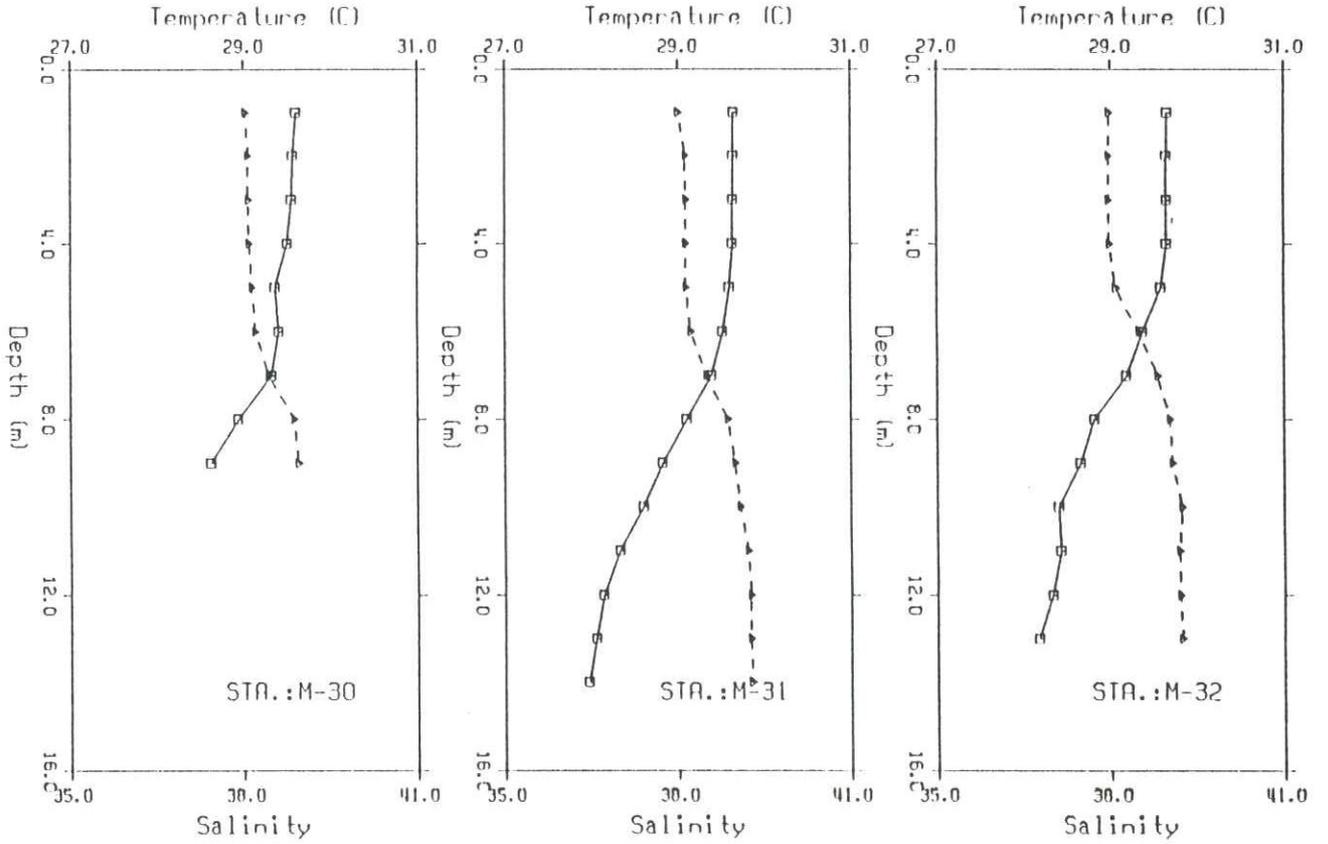
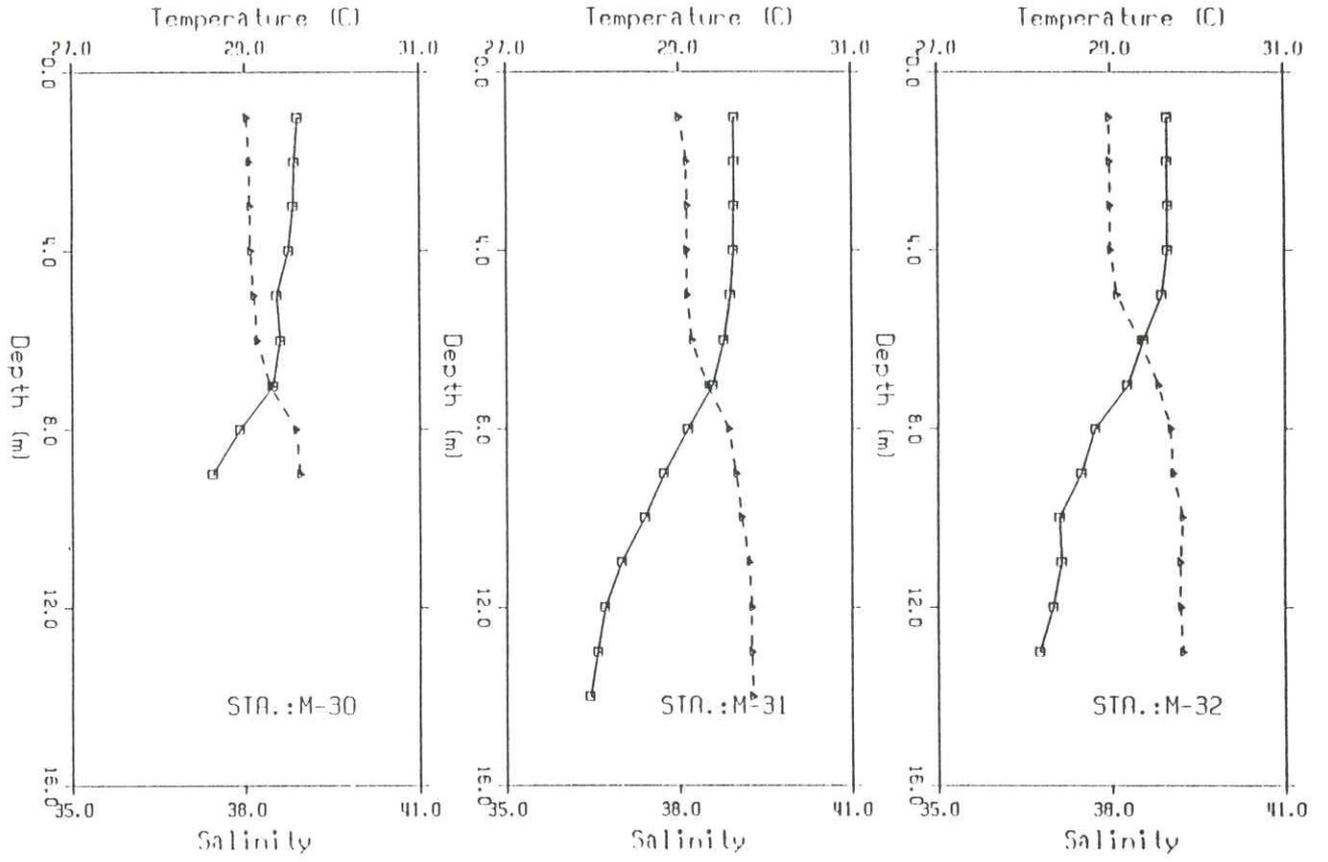
SEKİL. I. 4 Ağustos 1992 tuzluluk ve Sıcaklık profilleri



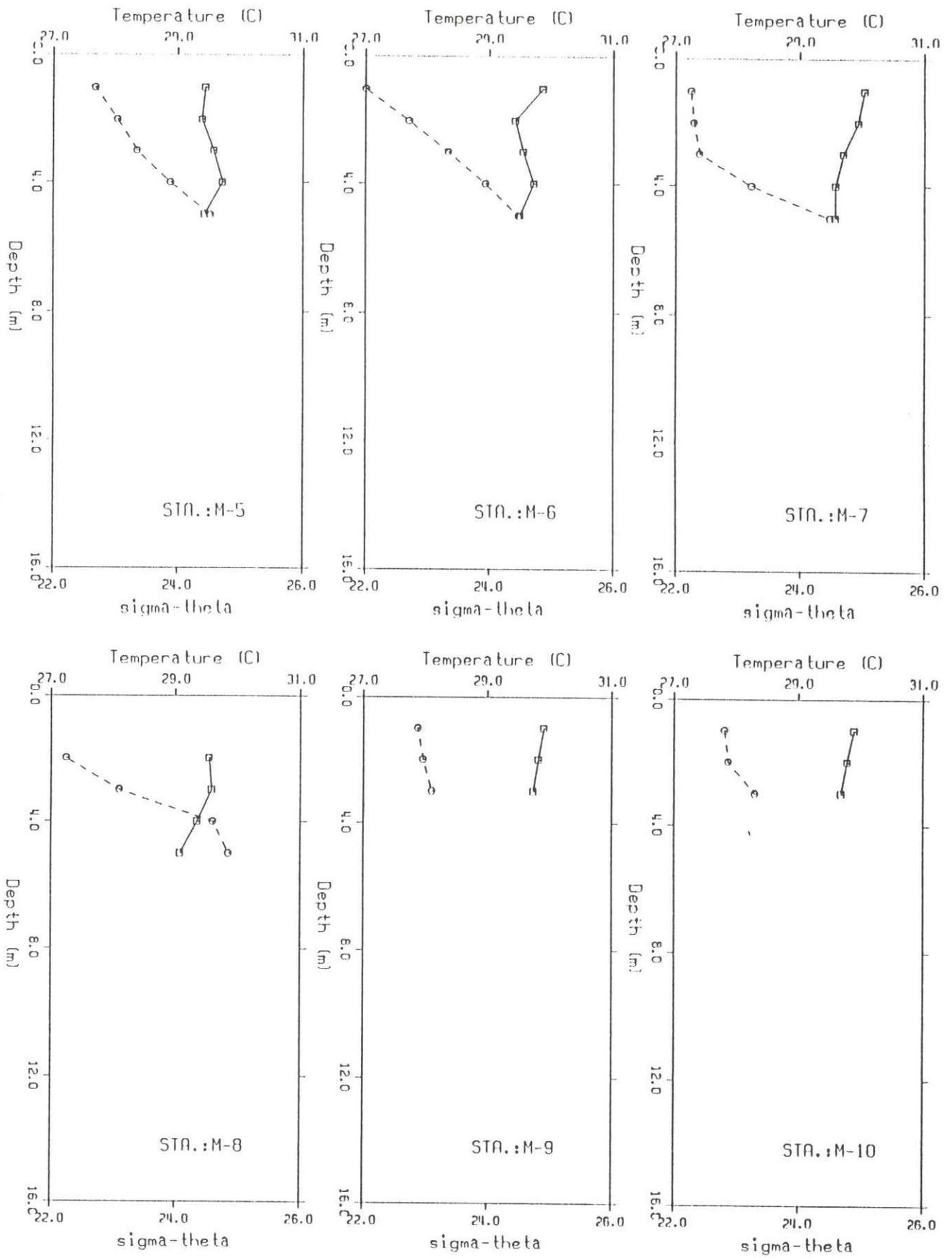
SEKİL. I.4 Ağustos 1992 tuzluluk ve Sıcaklık profilleri



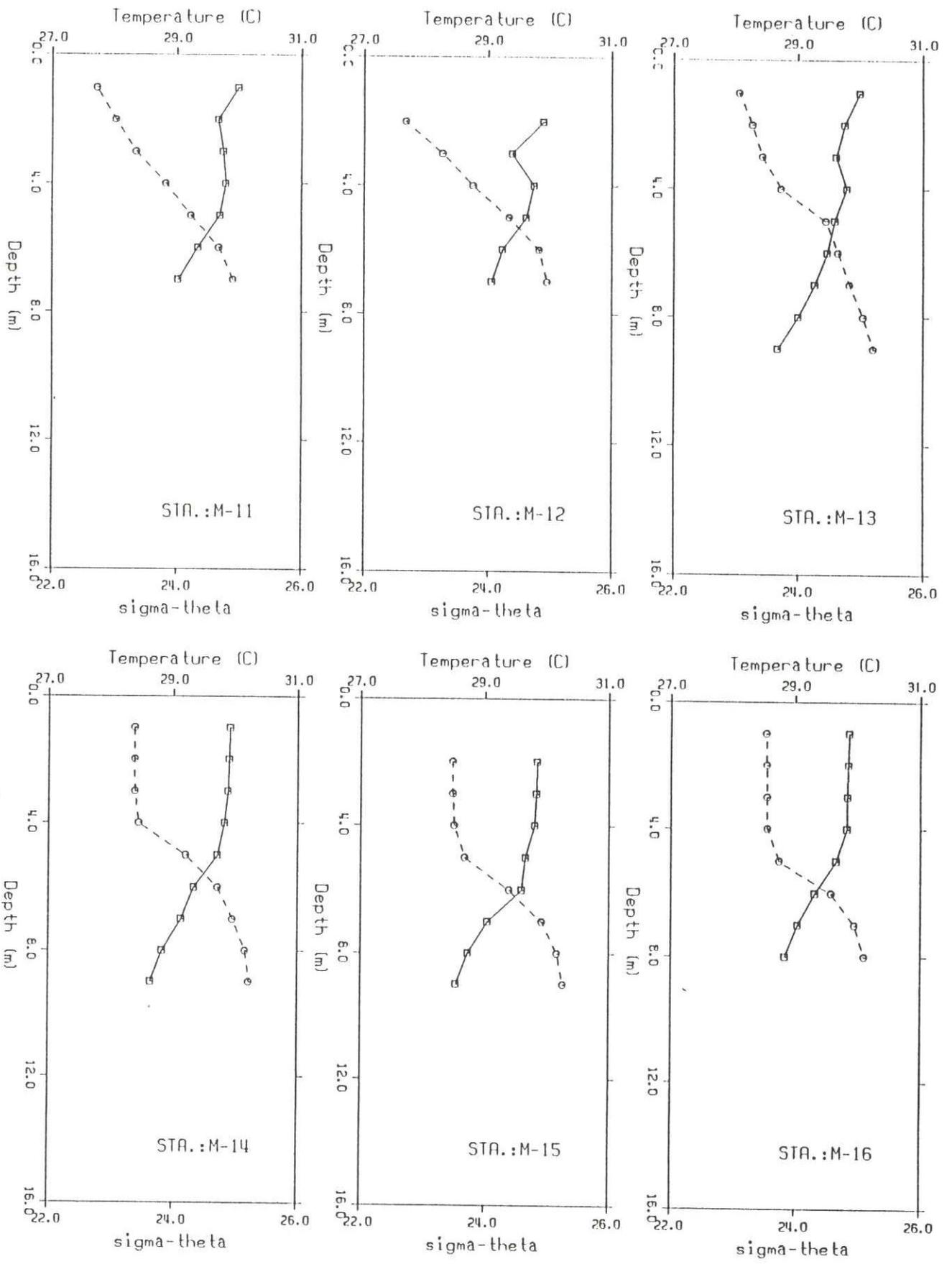
SEKİL. I. 4 Ağustos 1992 tuzluluk ve Sıcaklık profilleri



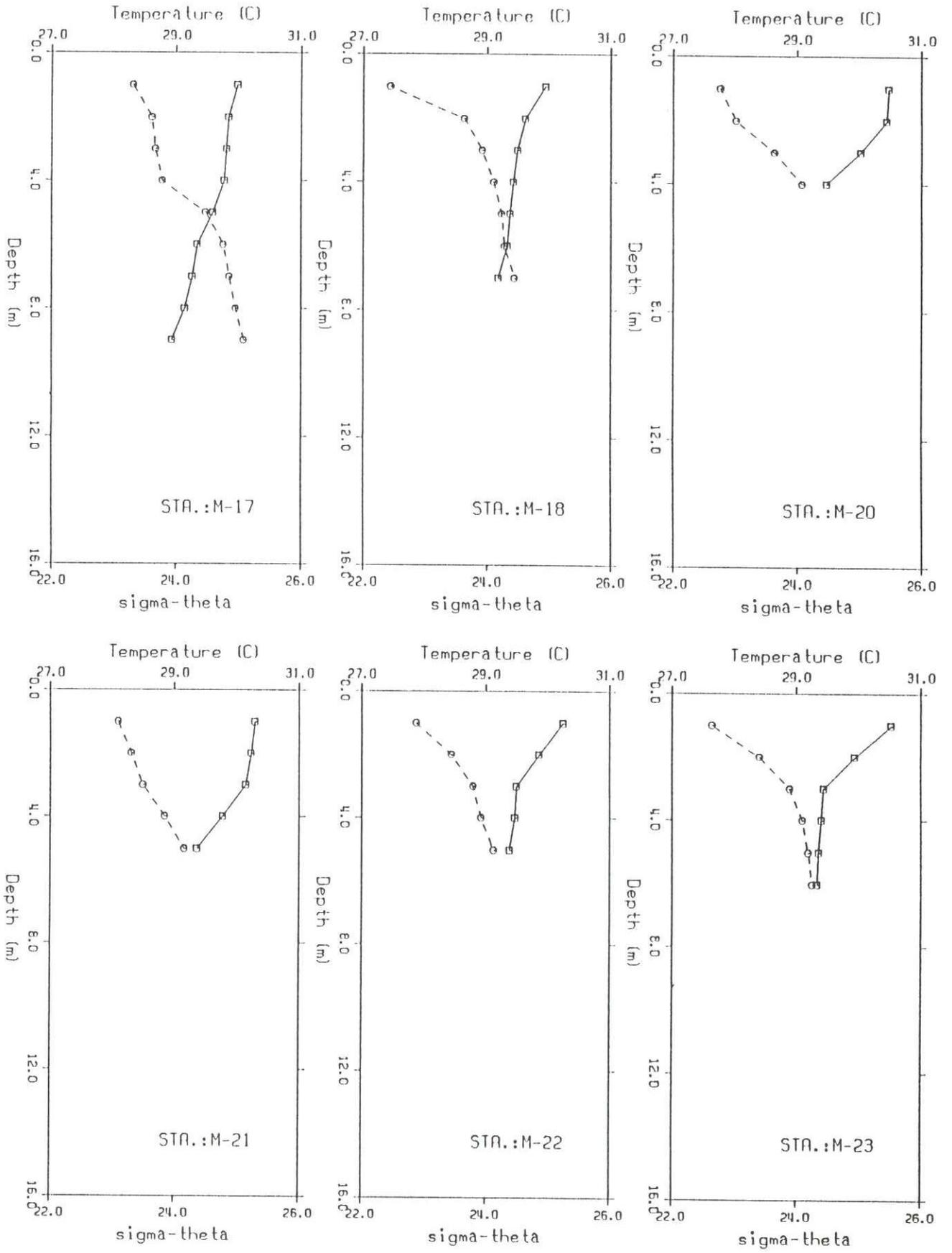
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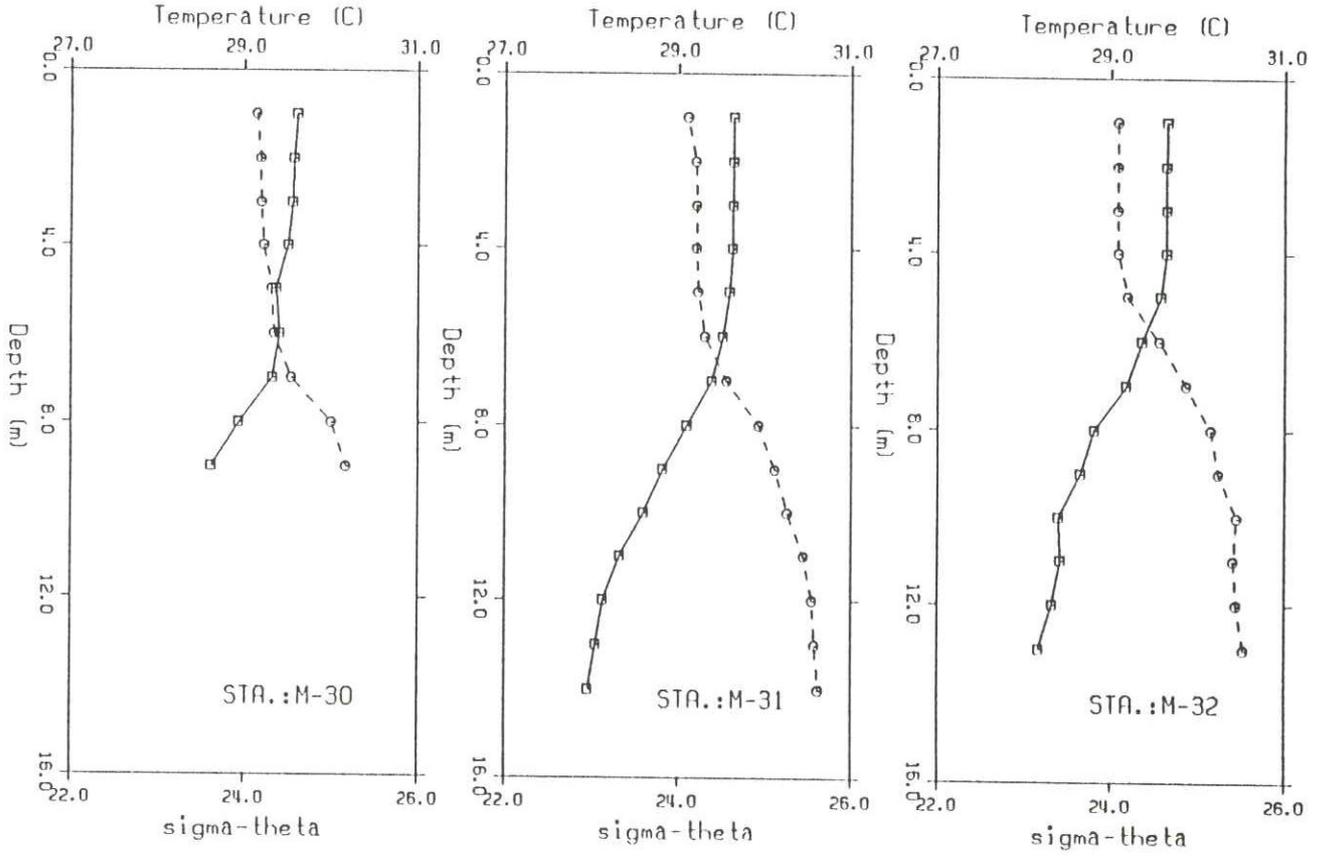
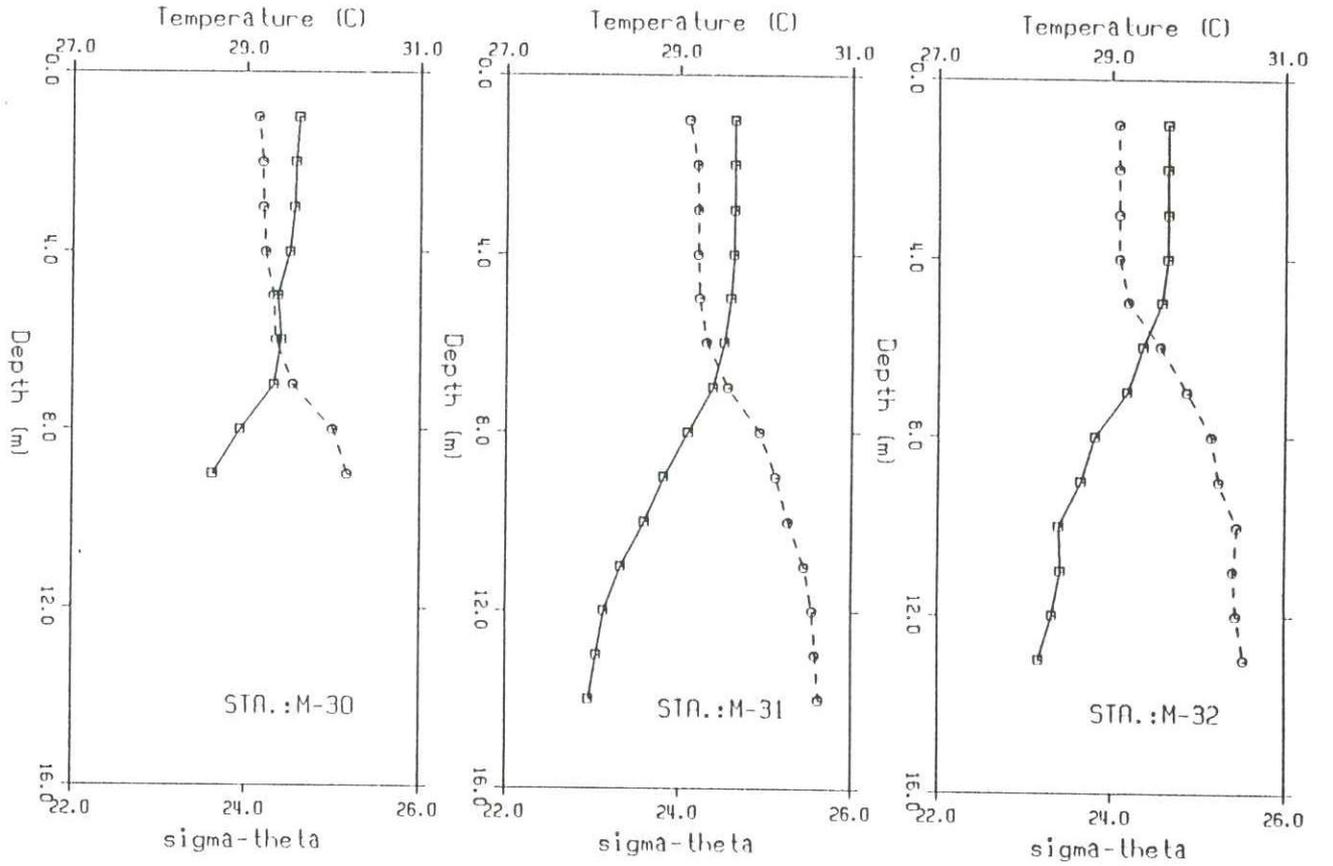
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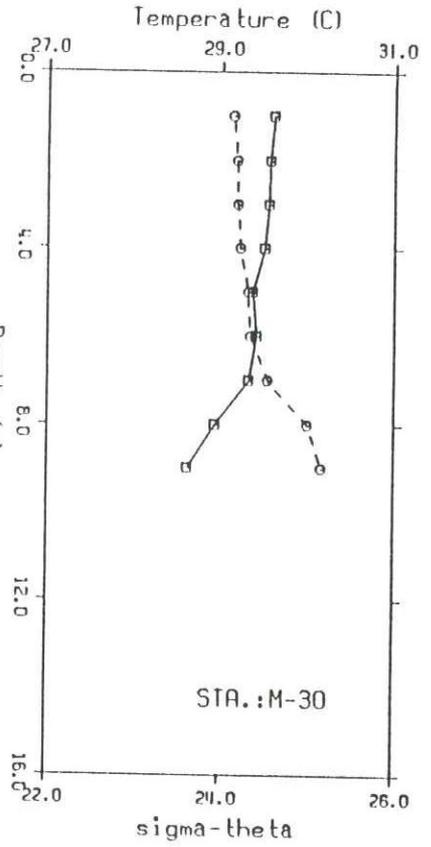
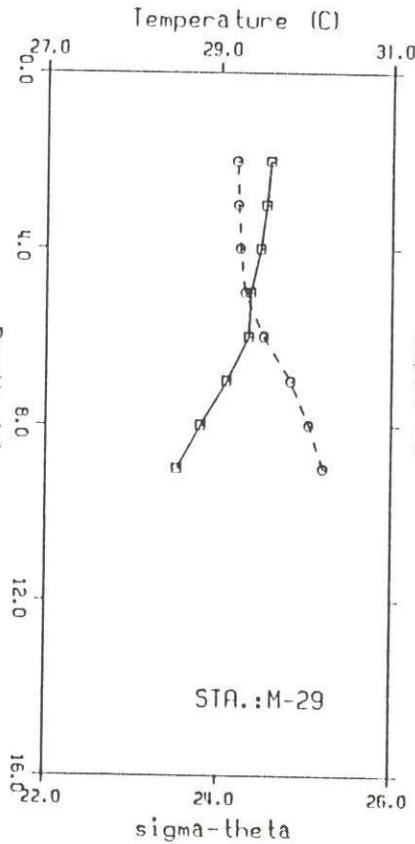
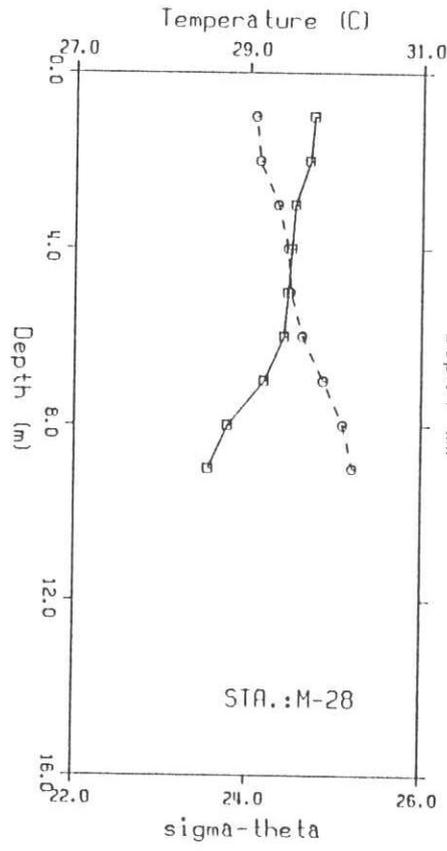
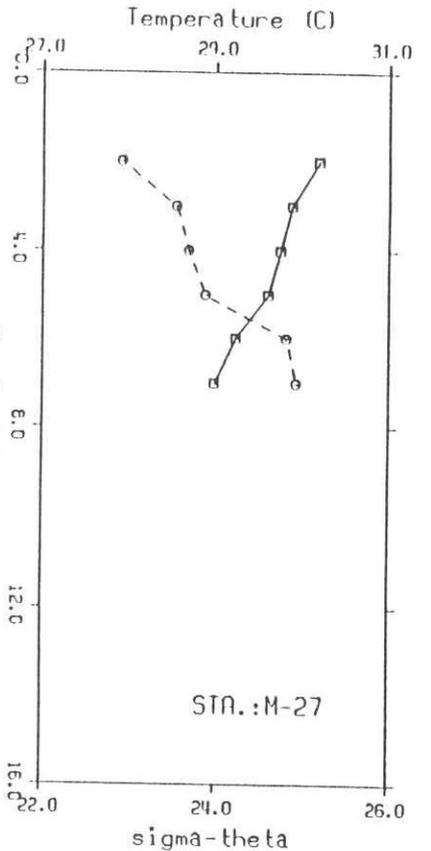
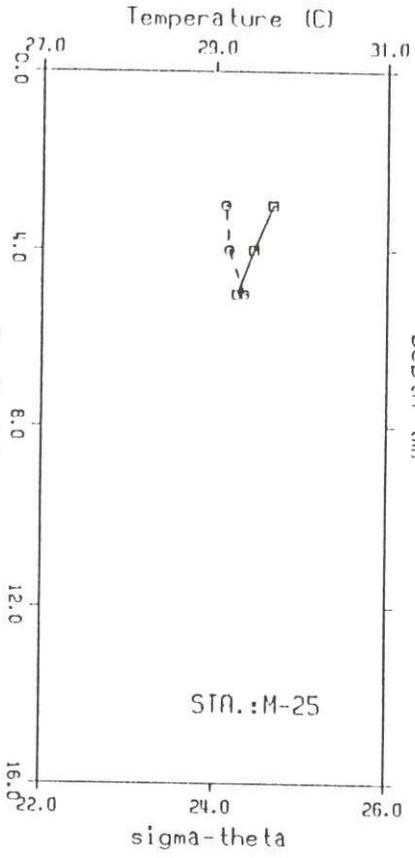
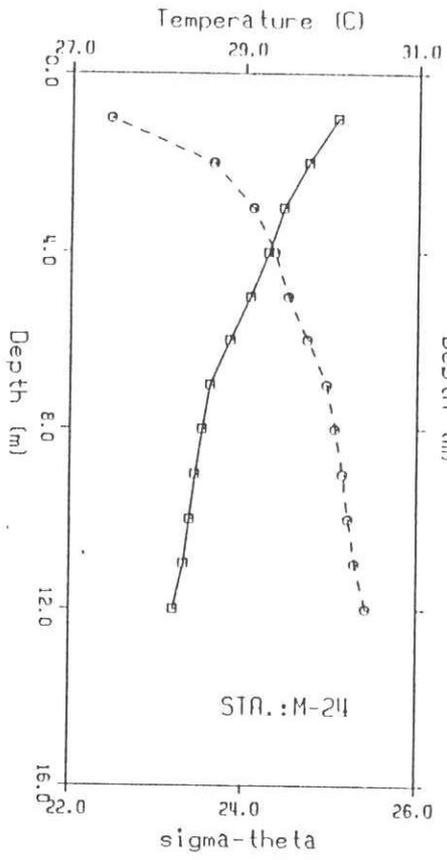
SEKİL. I.4 Ağustos 1992 Sıcaklık ve Yoğunluk profilleri



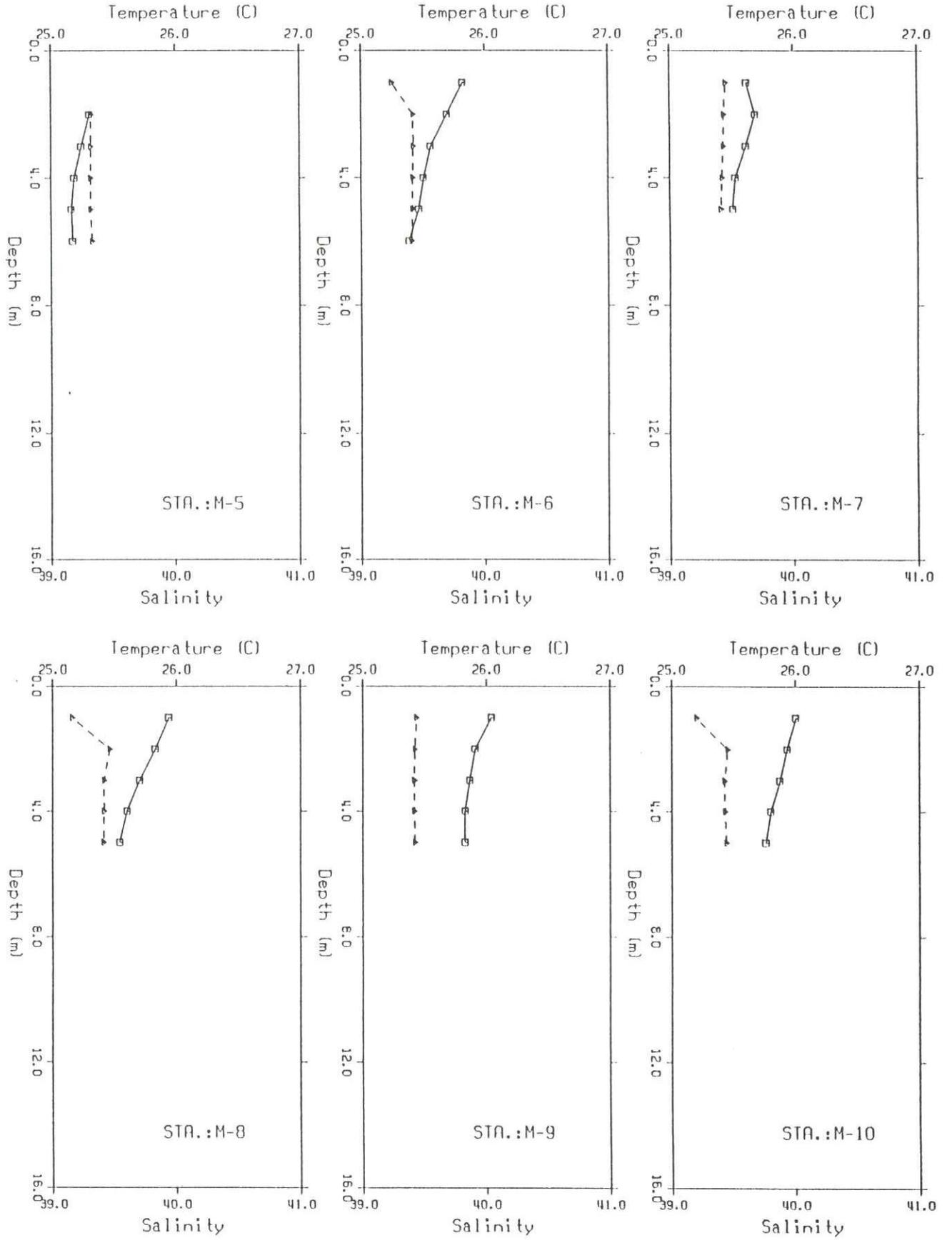
SEKİL.I.4 Ağustos 1992 Sıcaklık ve Yoğunluk profilleri



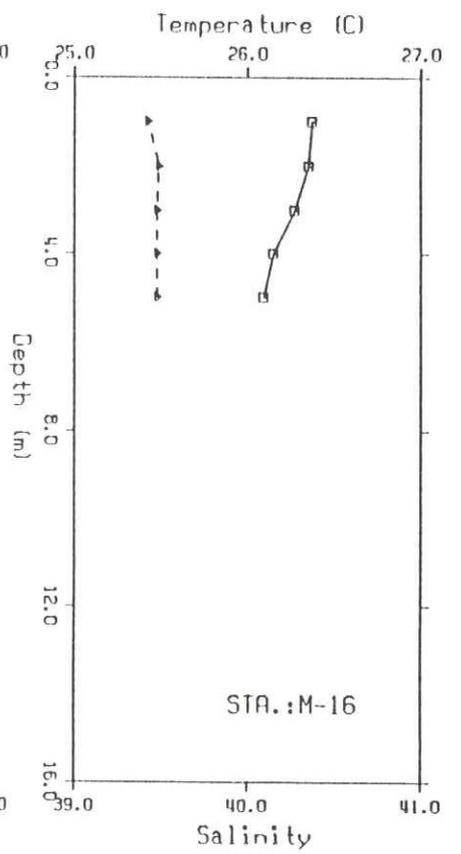
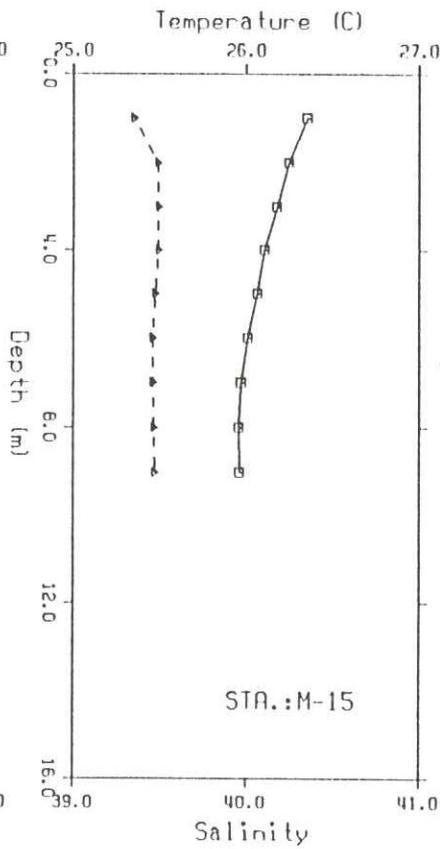
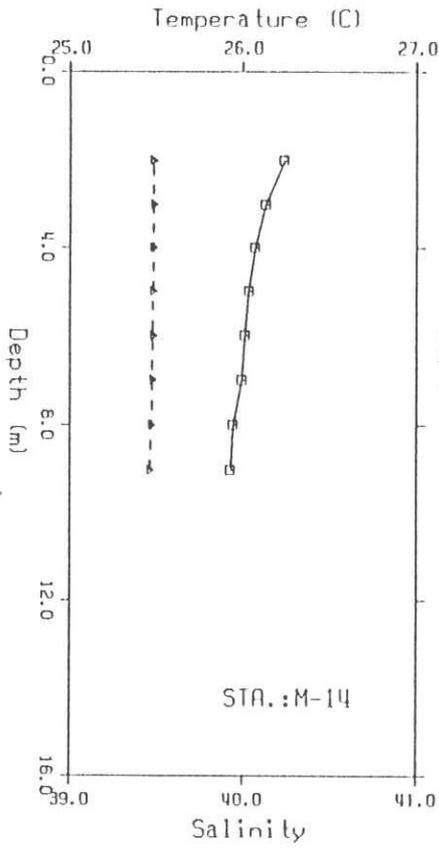
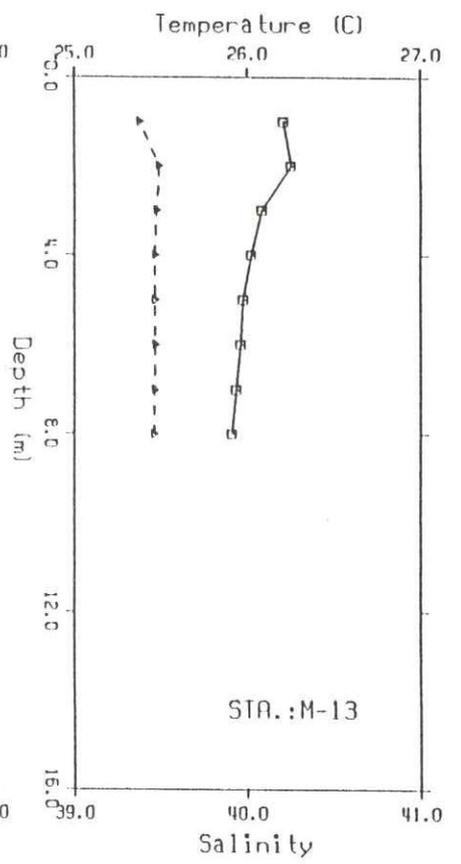
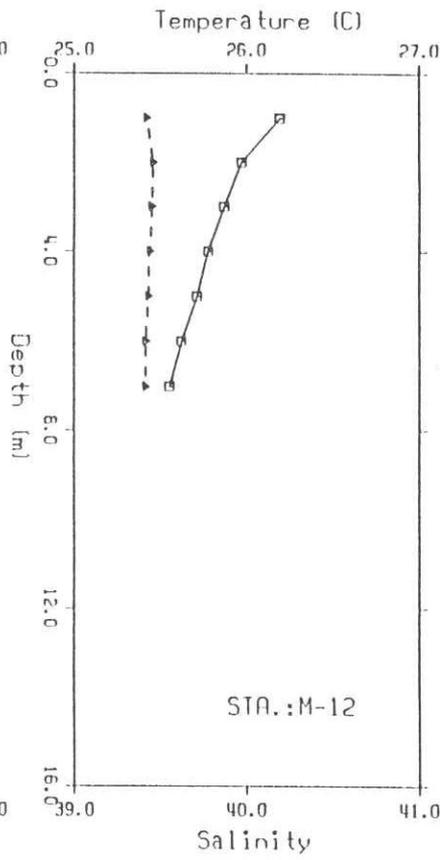
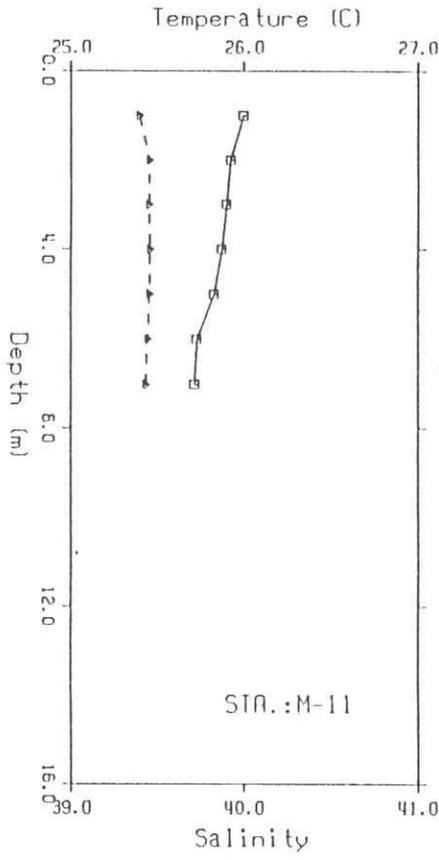
SEKİL. I.4 Agustos 1992 Sıcaklık ve Yoğunluk profilleri



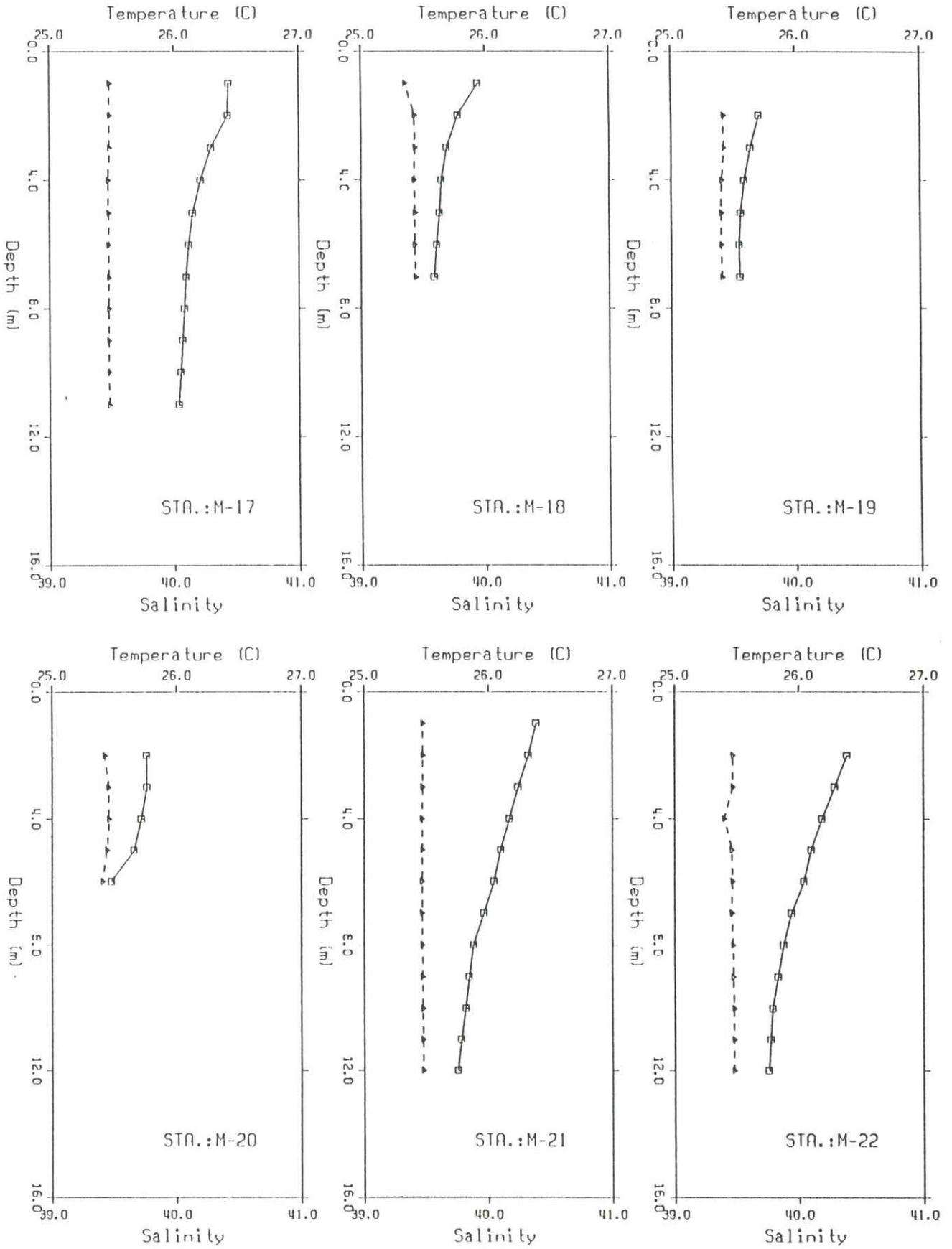
SEKİL. I. 4 Ağustos 1992 Sıcaklık ve Yoğunluk profilleri



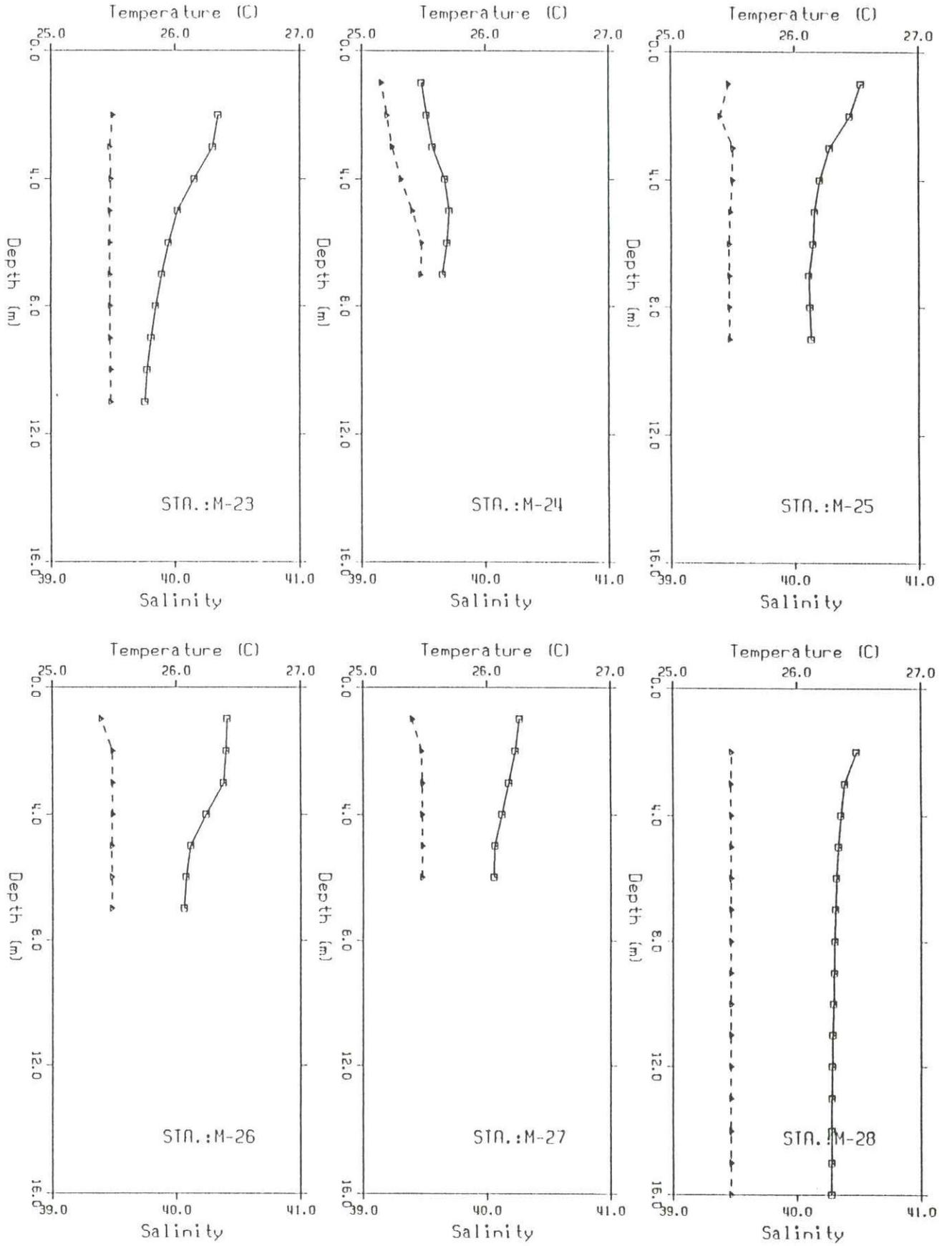
SEKİL. I.5 Ekim 1992 tuzluluk ve Sıcaklık profilleri



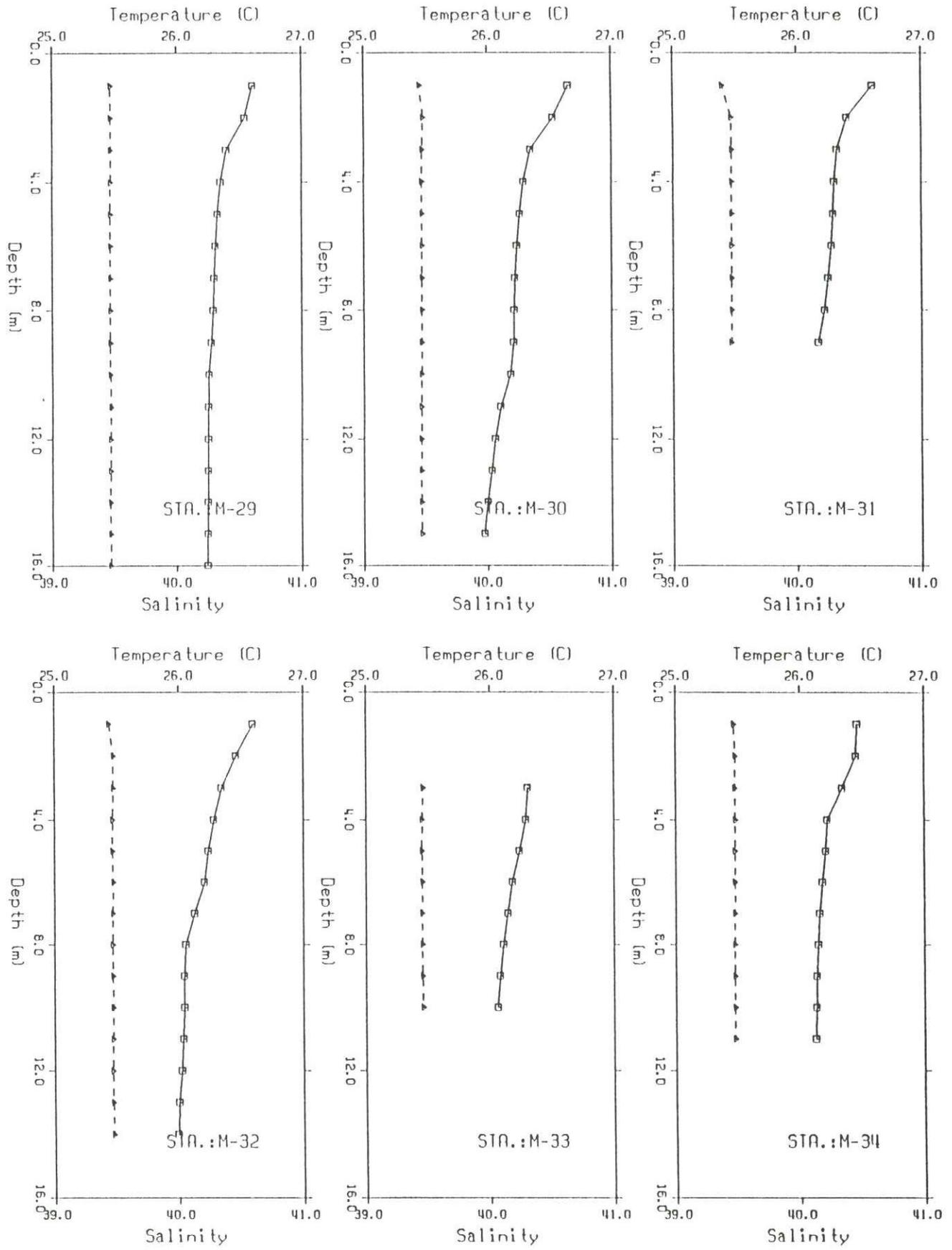
SEKİL. I.5 Ekim 1992 tuzluluk ve Sıcaklık profilleri



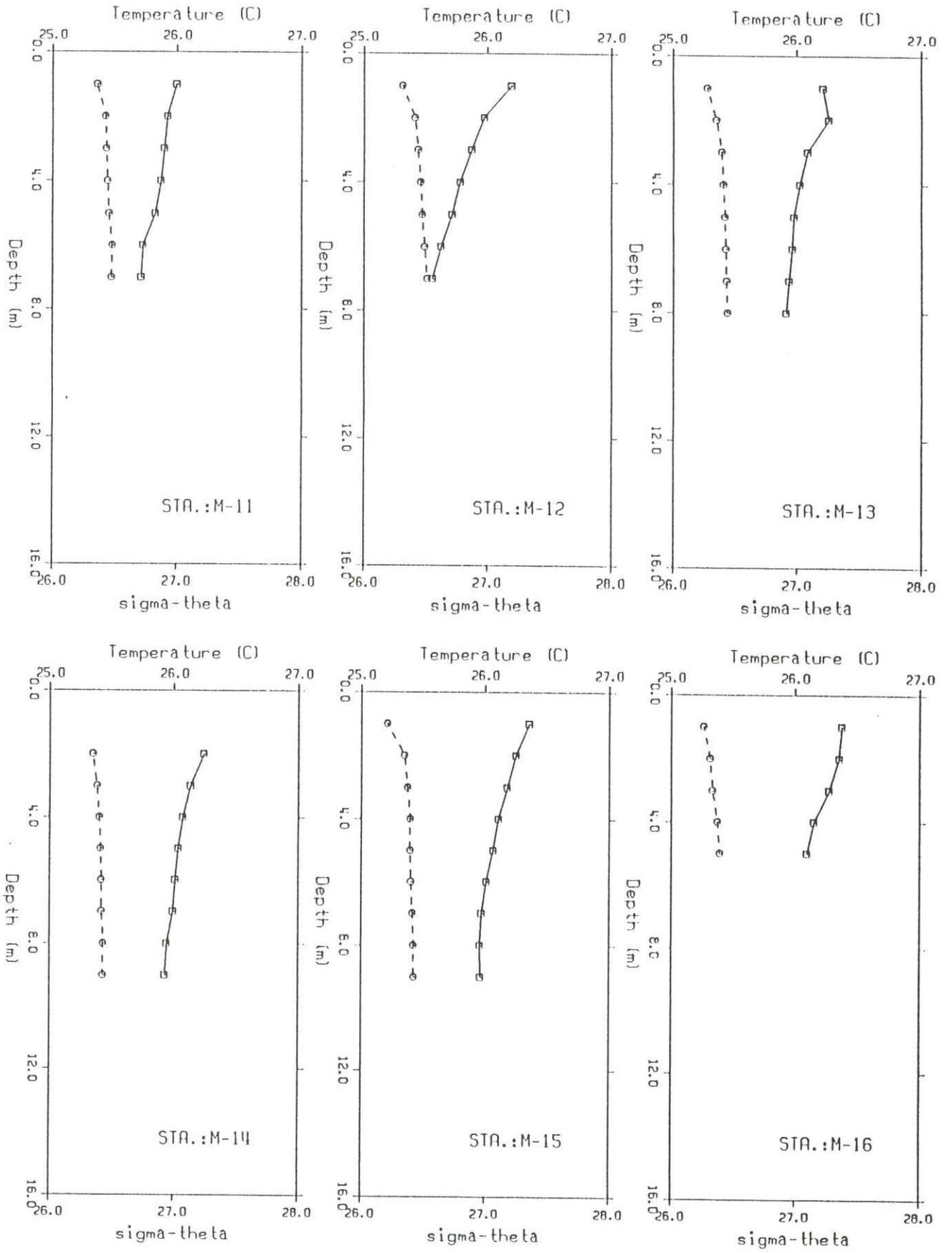
SEKİL. I.5 Ekim 1992 tuzluluk ve Sıcaklık profilleri



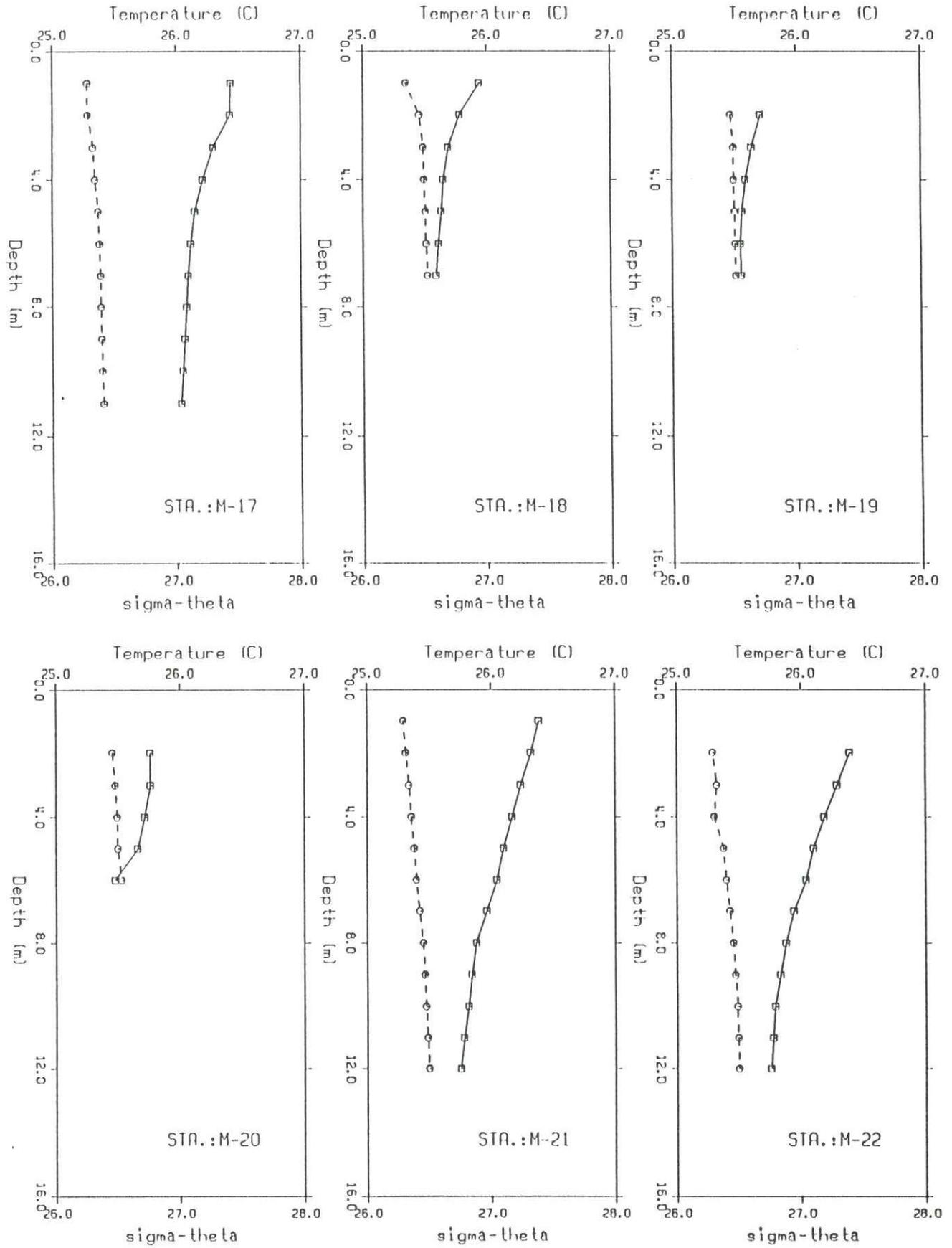
SEKİL. I.5 Ekim 1992 tuzluluk ve Sıcaklık profilleri



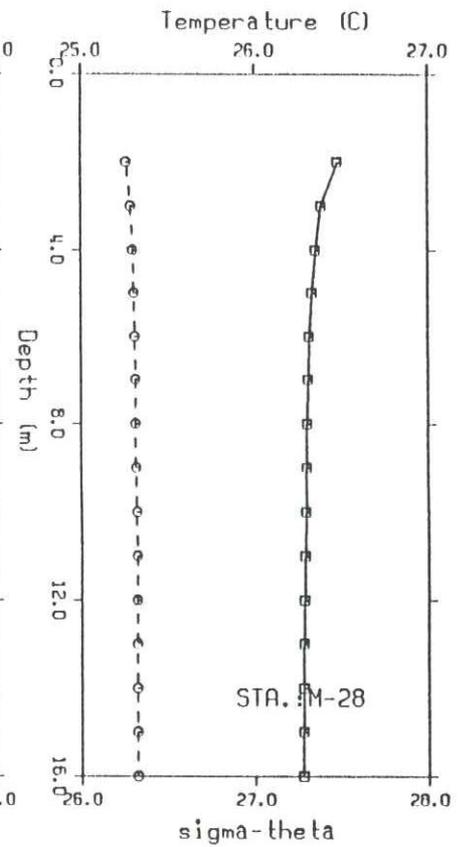
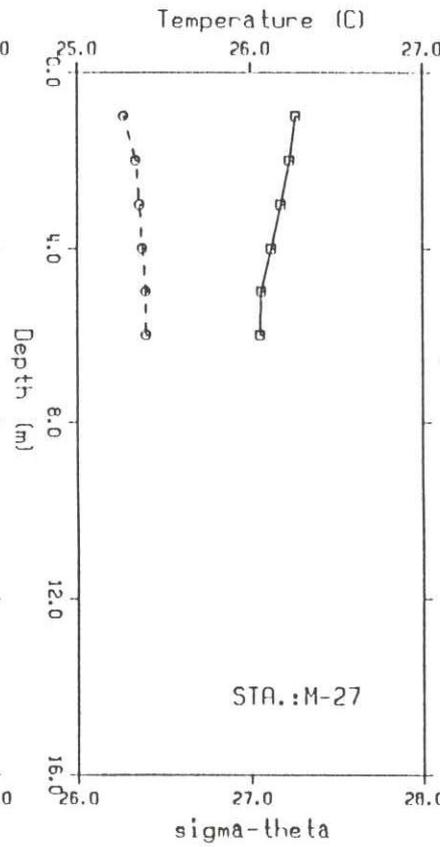
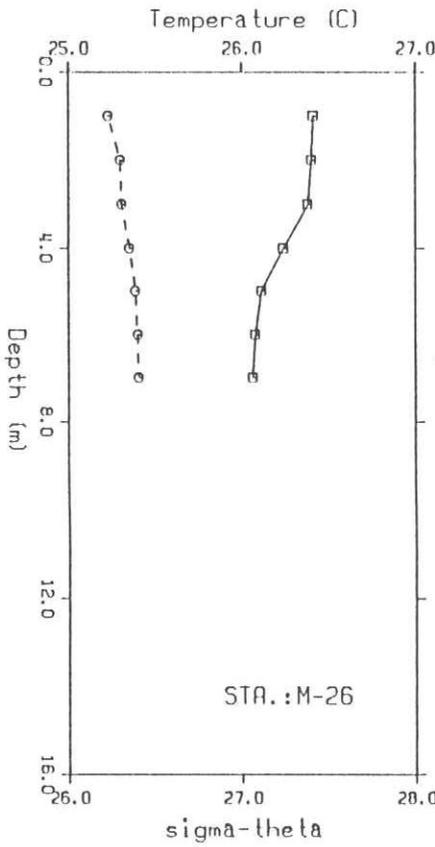
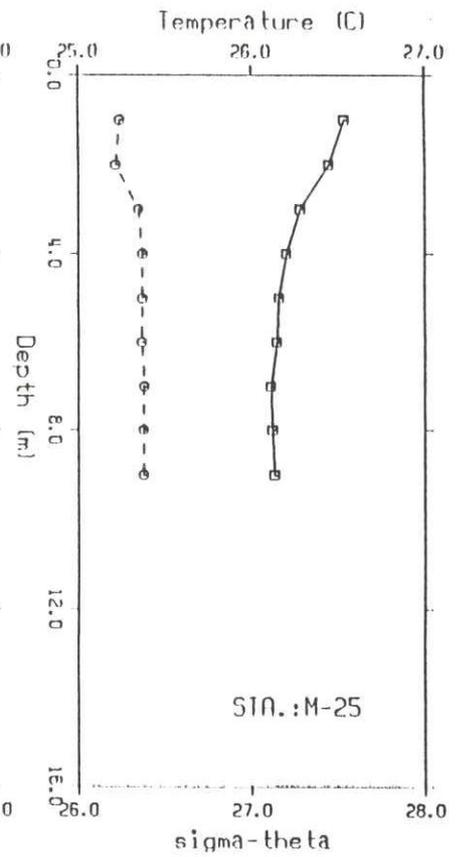
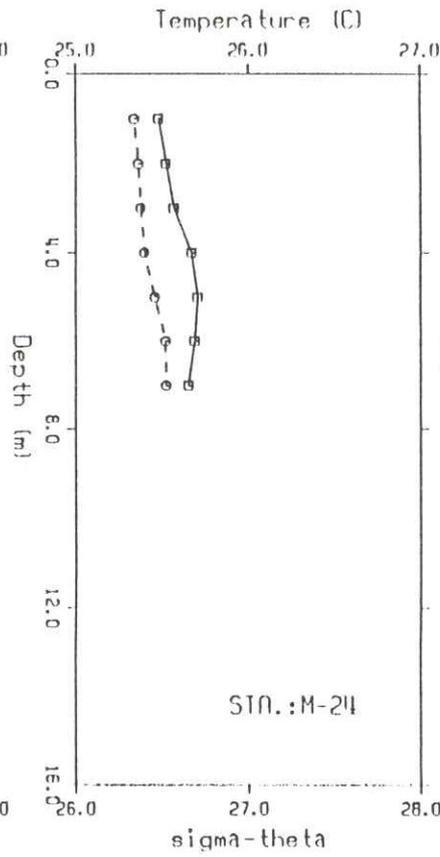
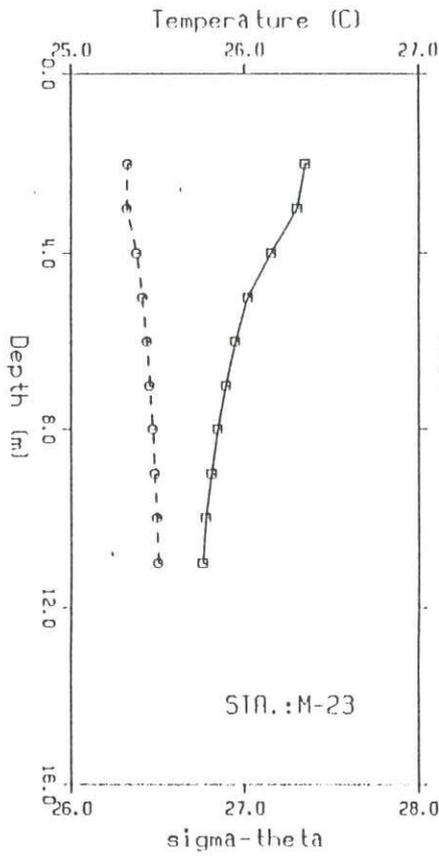
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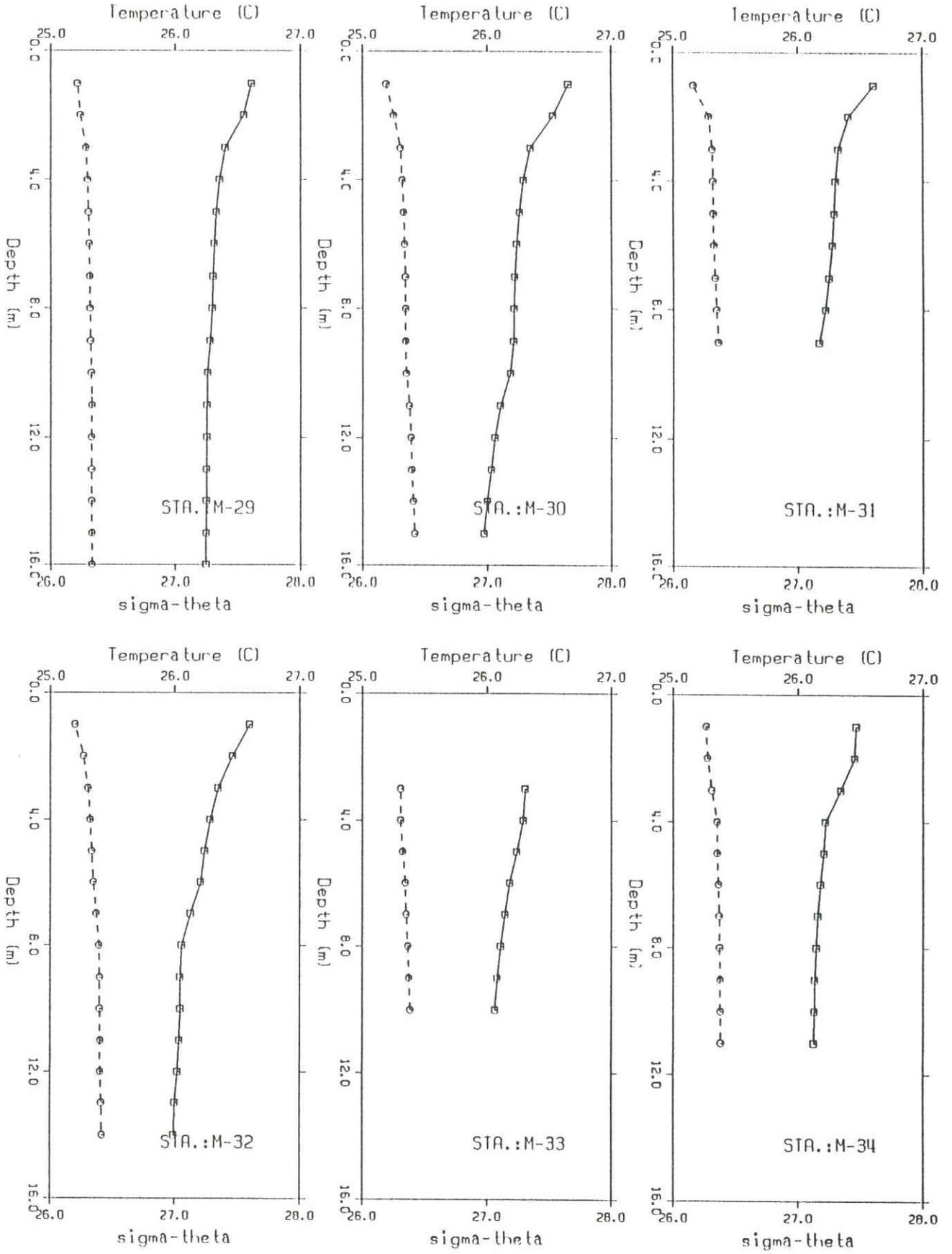
ŞEKİL. I.5 Ekim 1992 Sıcaklık ve Yoğunluk profilleri



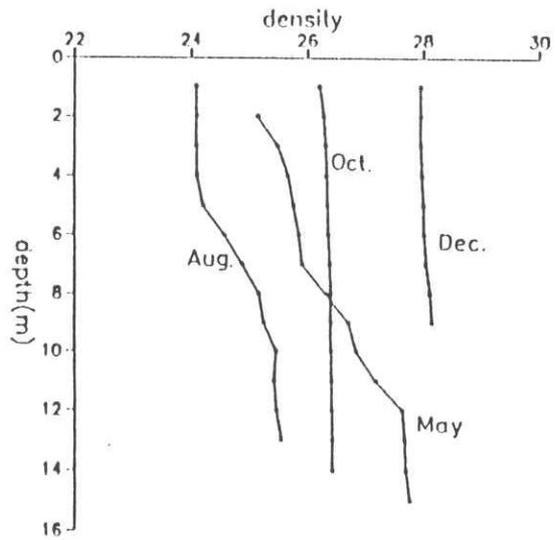
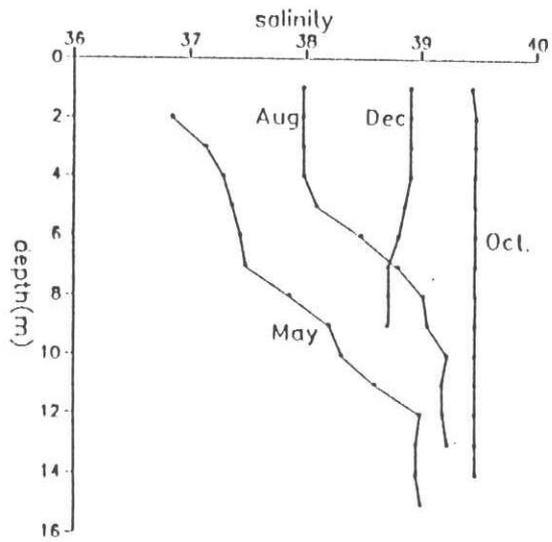
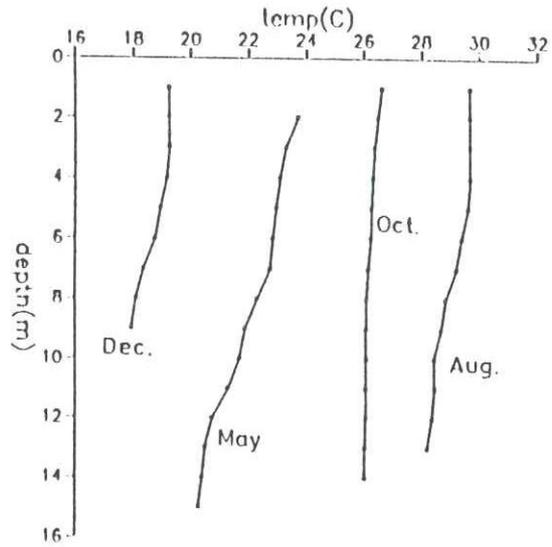
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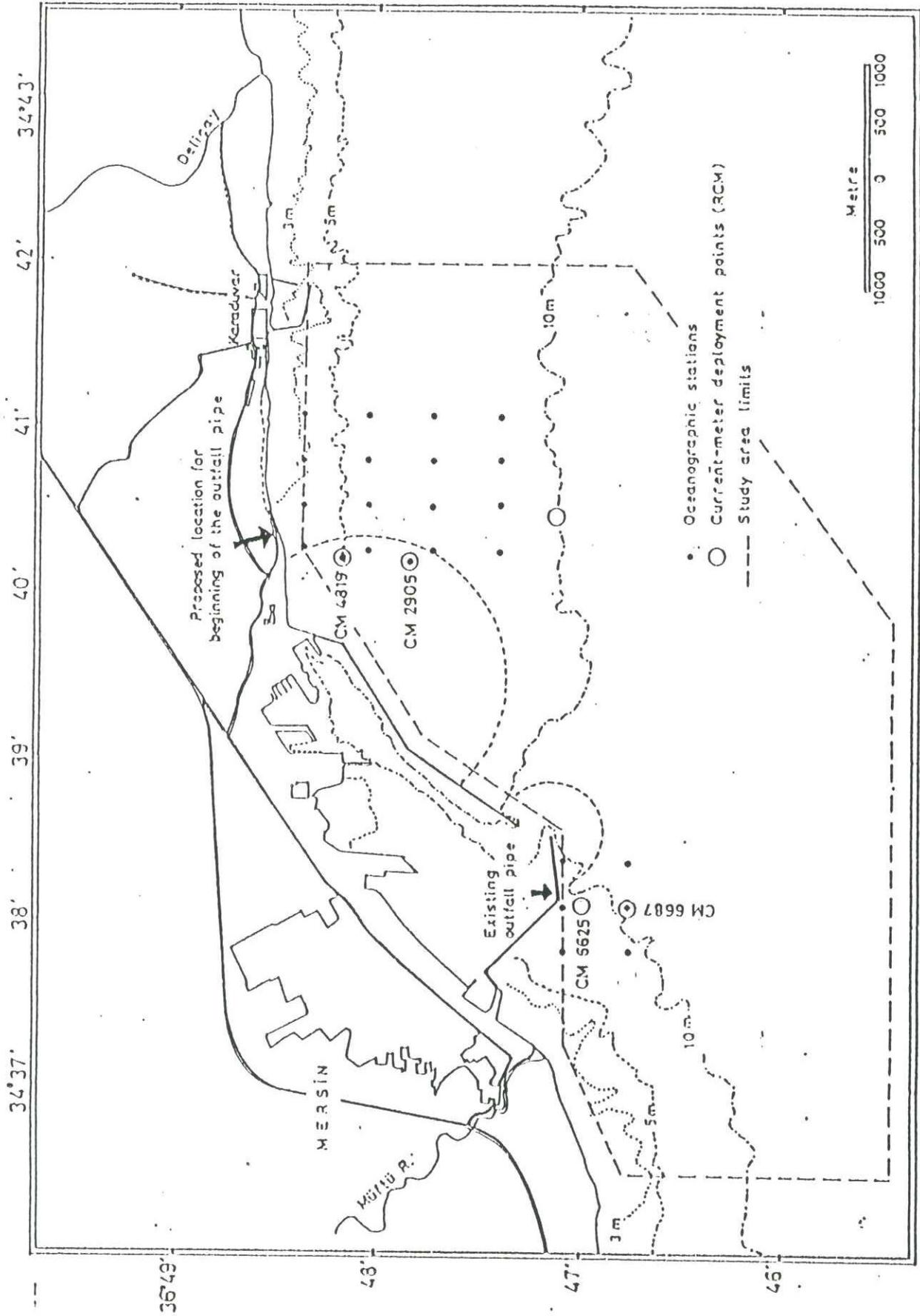
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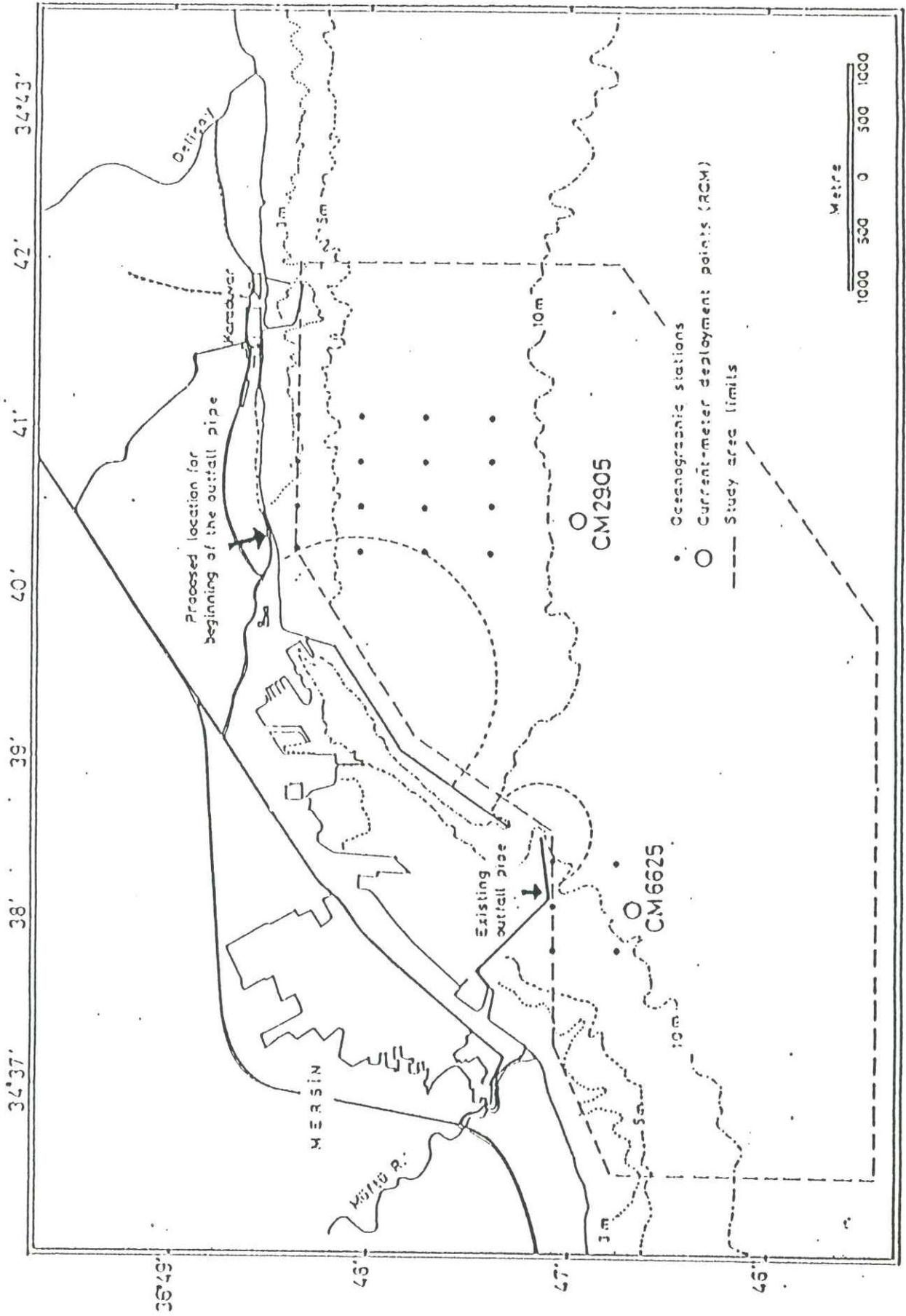
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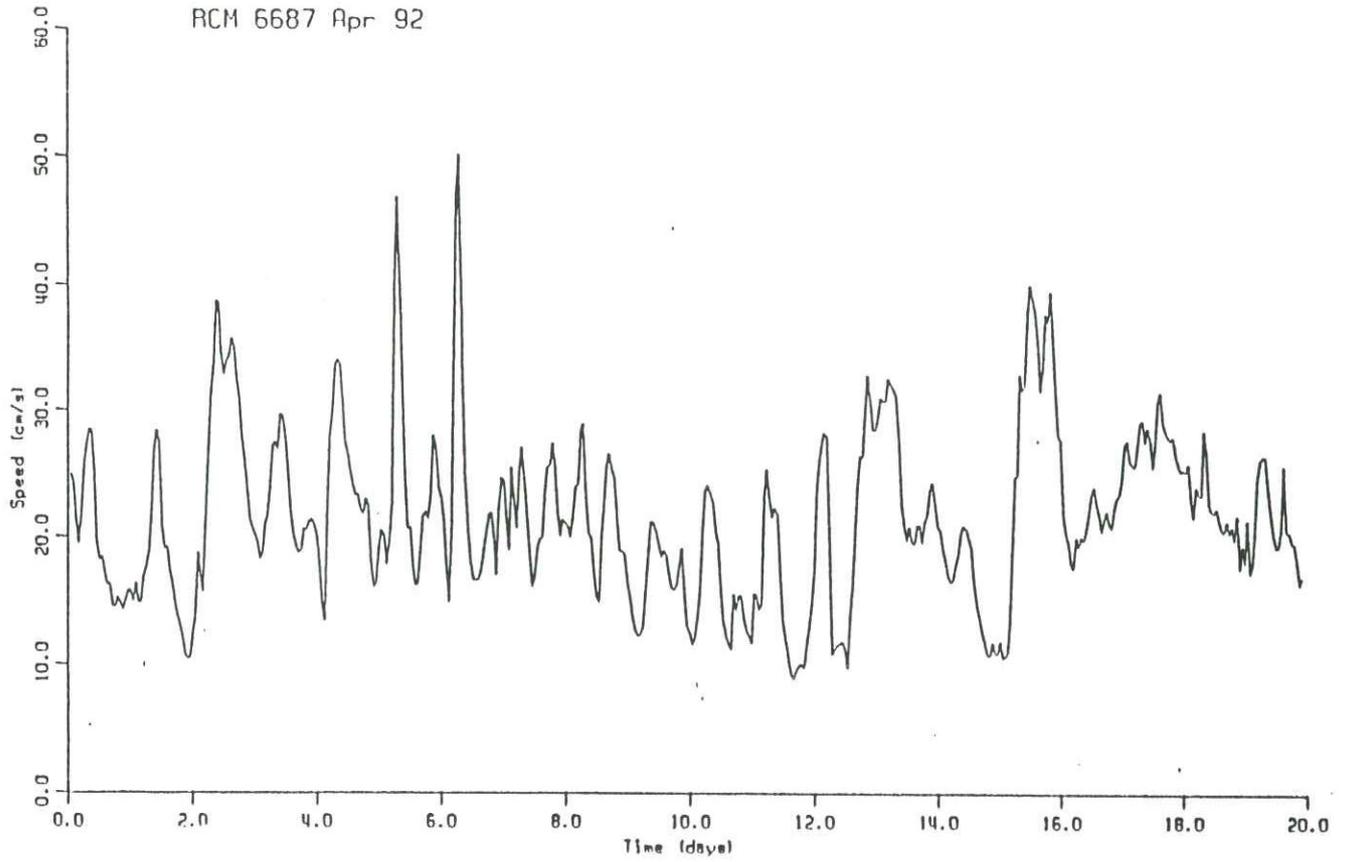
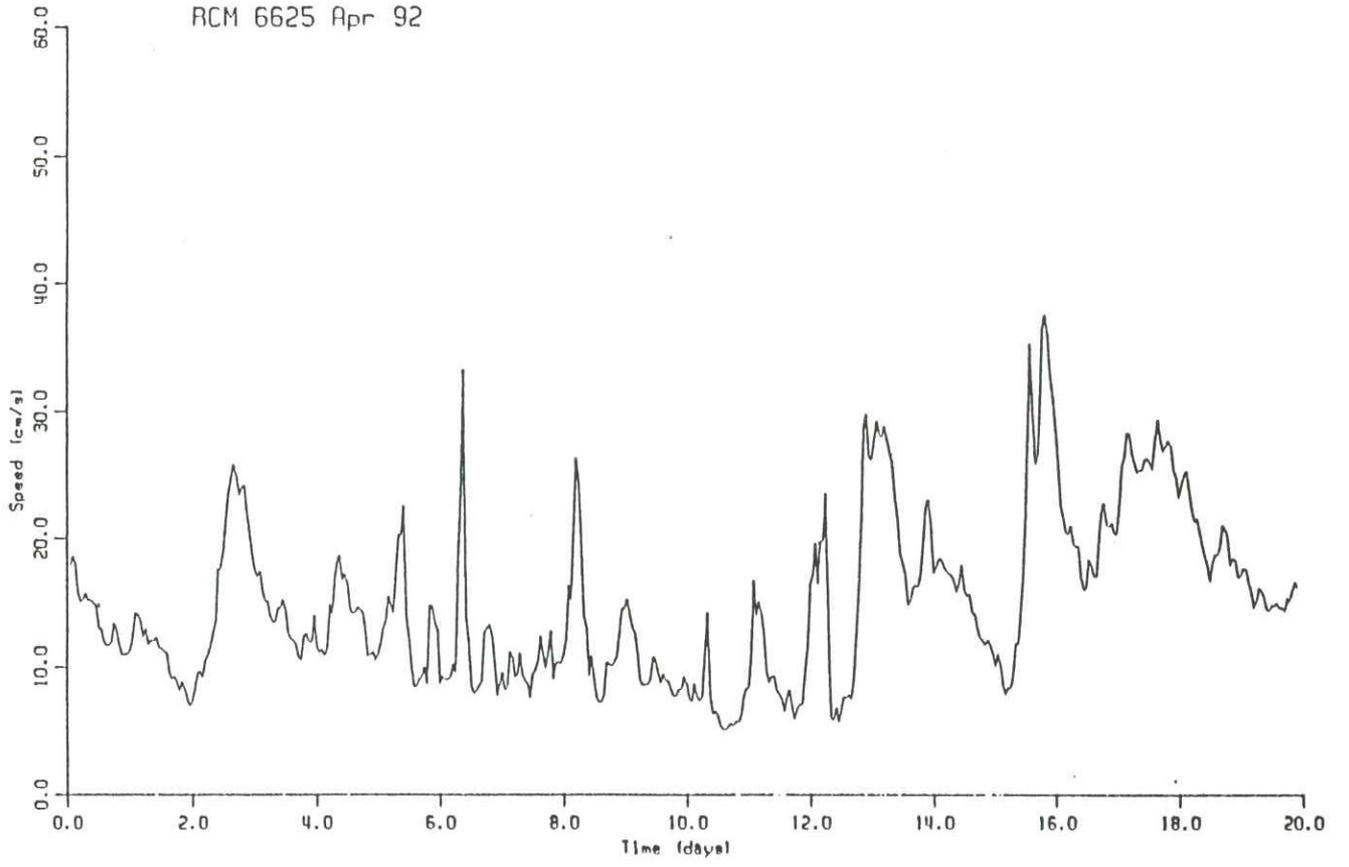
SEKİL. I.6 M-32' deki 4 seferin profilleri



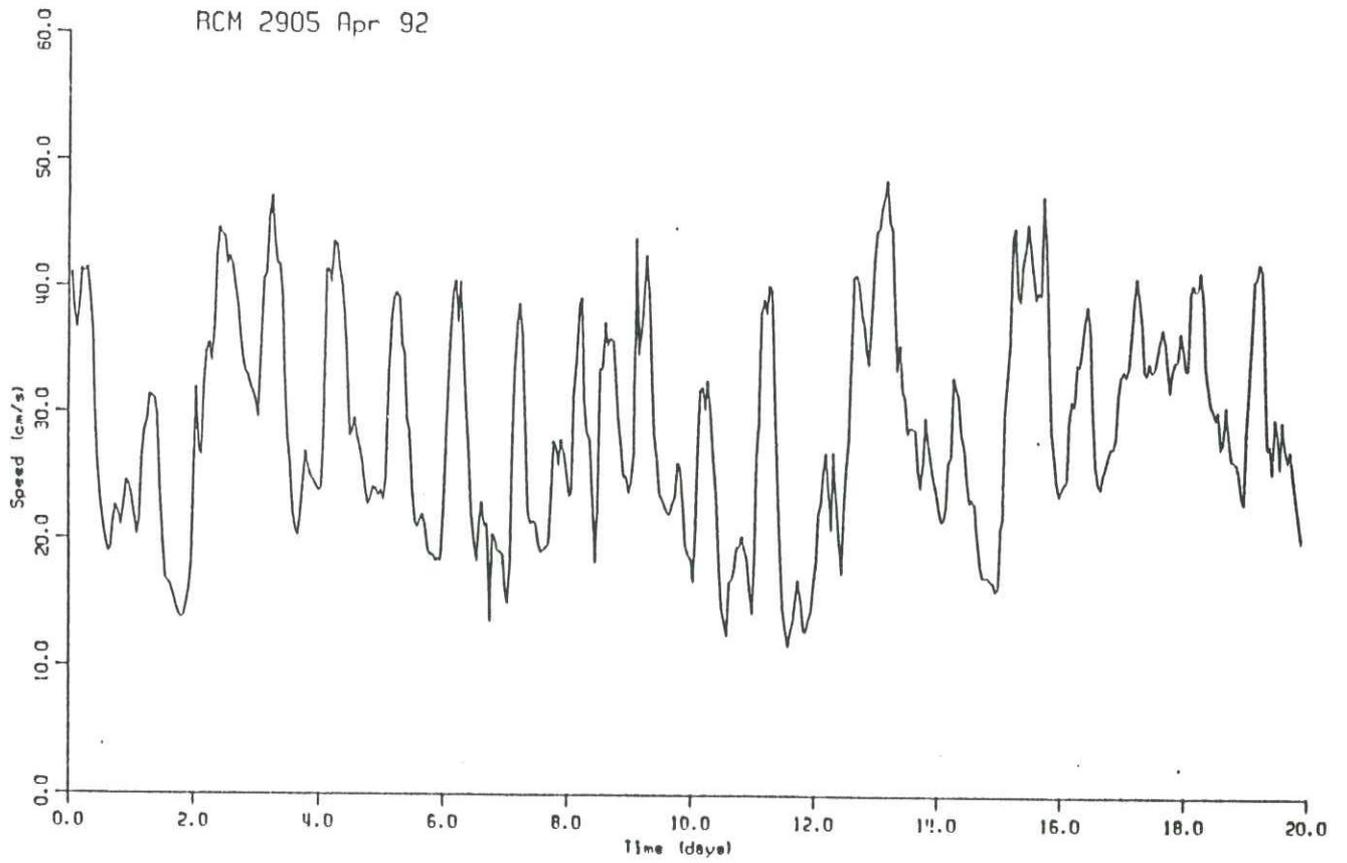
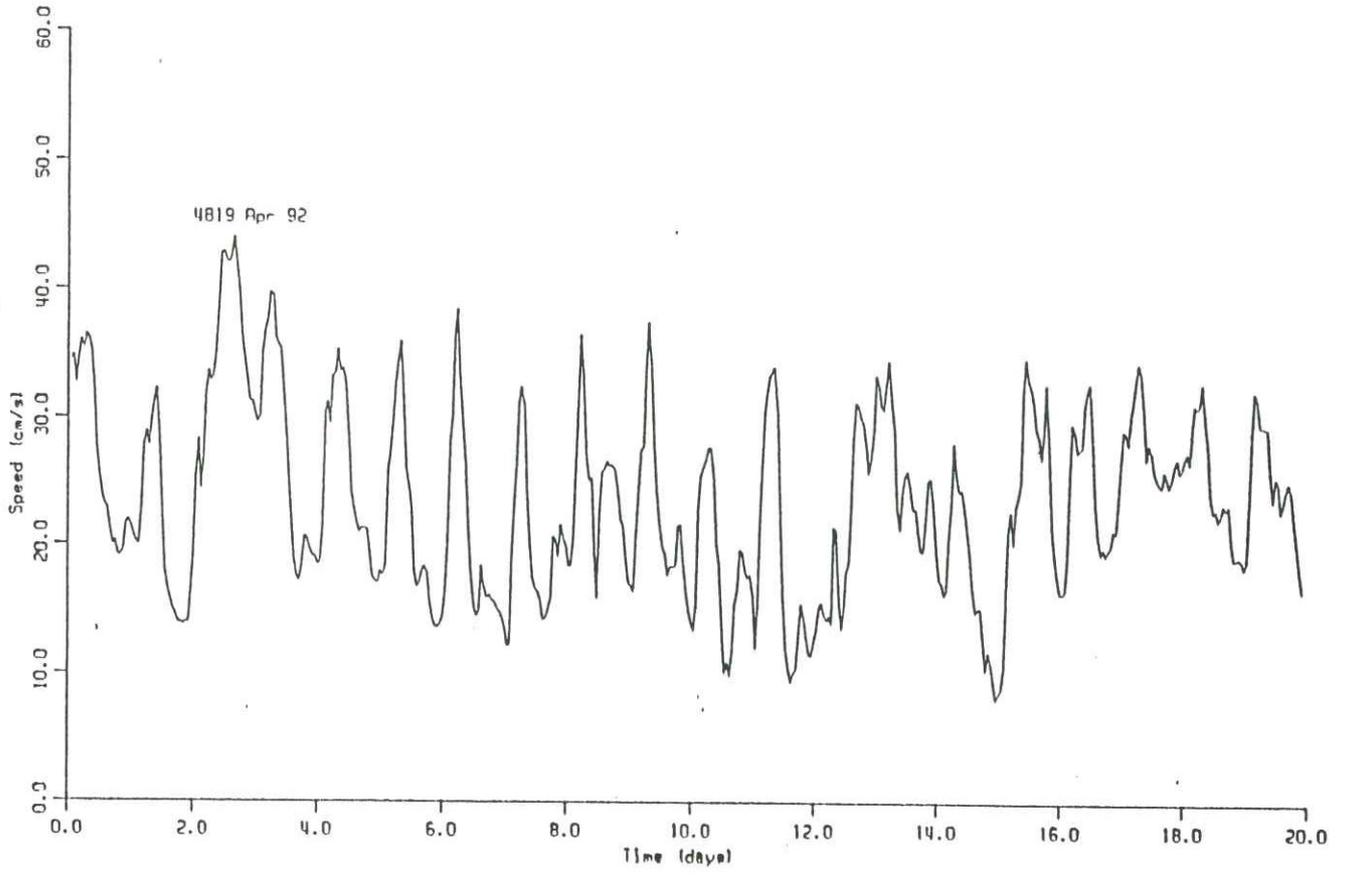
SEKİL I.7 Nisan-mayıs 1992 akıntı ölçer istasyonları



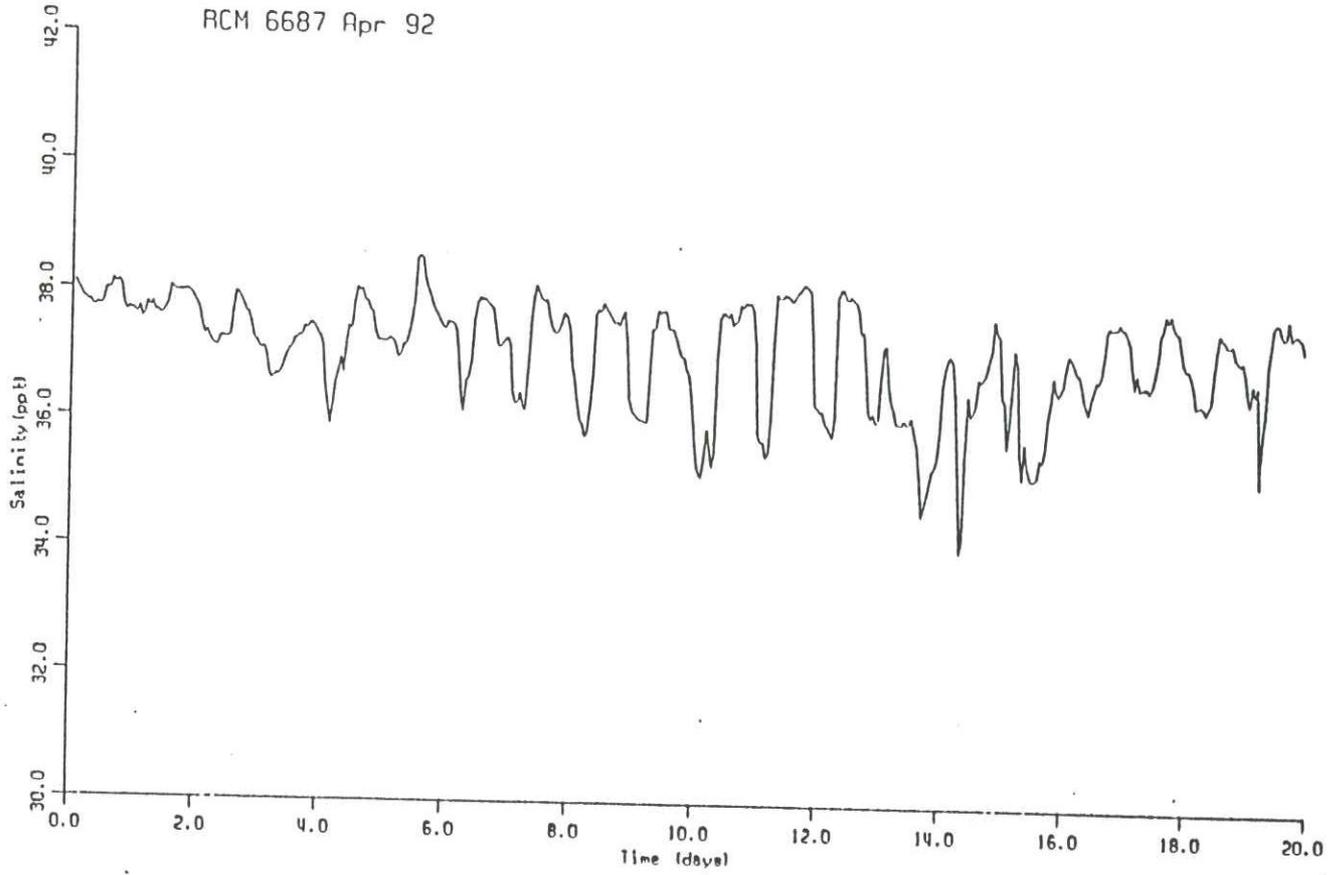
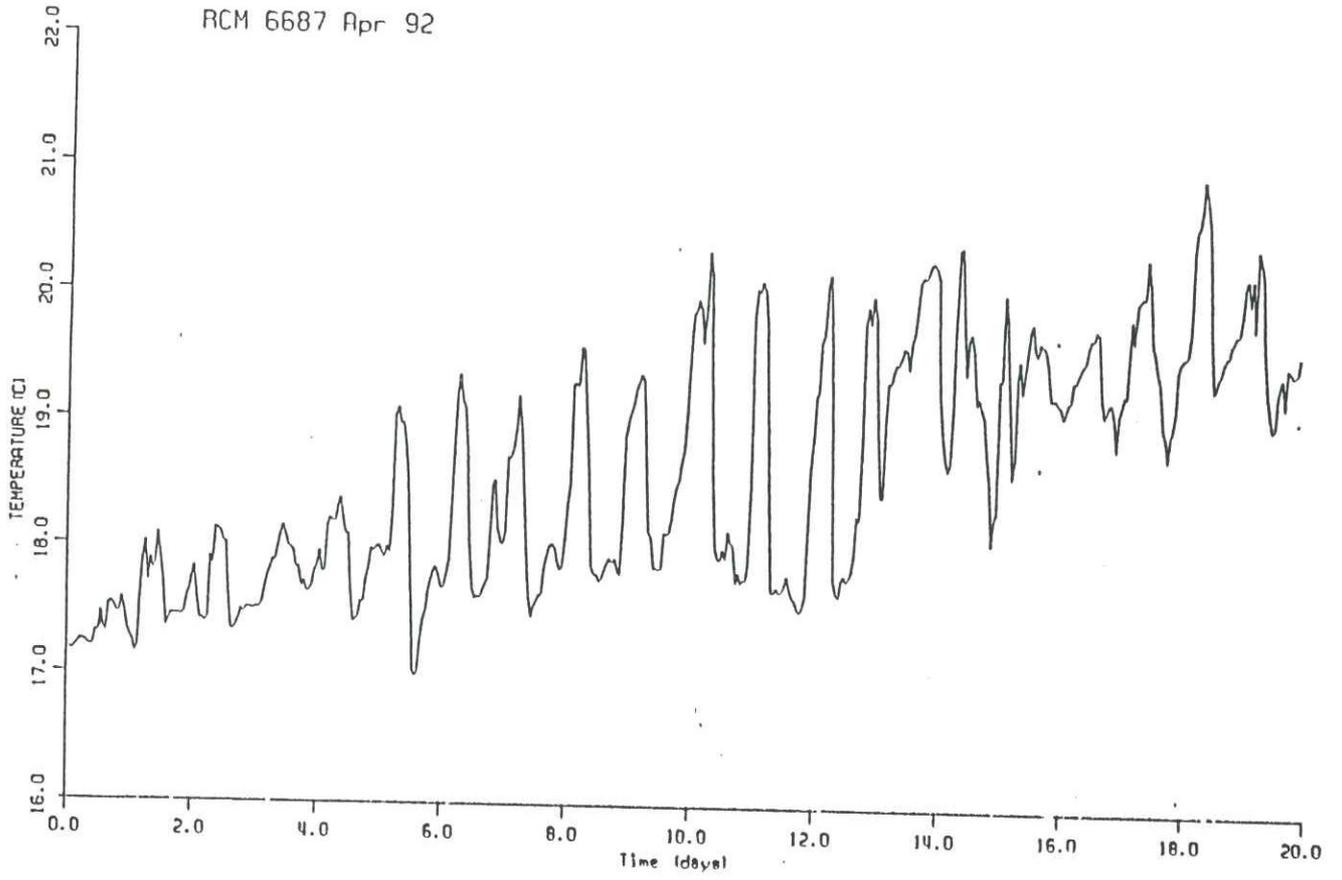
SEKİL. I.8 Temmuz-Agustos 1992 akıntı ölçer istasyonları



SEKİL. I.9 Nisan-Mayıs 1992 akıntı hızı zaman serileri



SEKİL. I.10 Nisan-Mayıs 1992 akıntı hızı zaman serileri

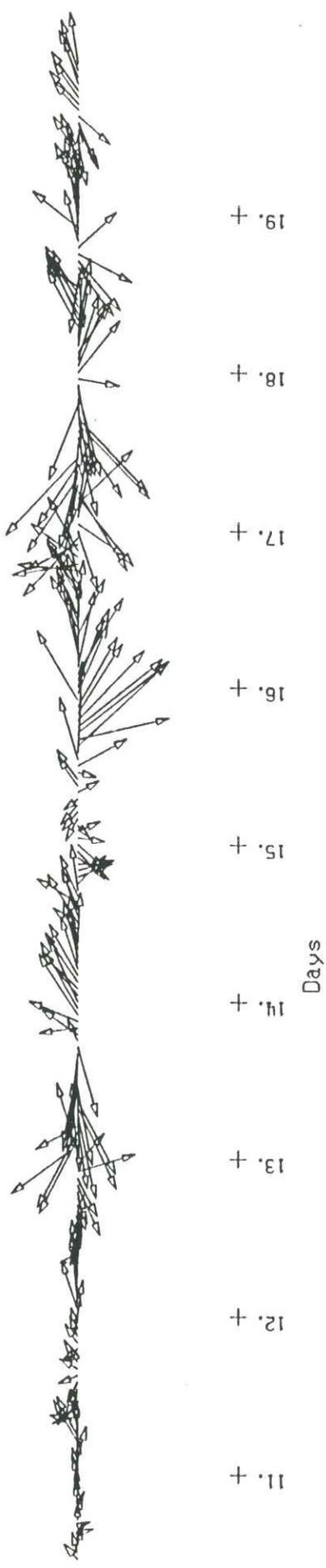
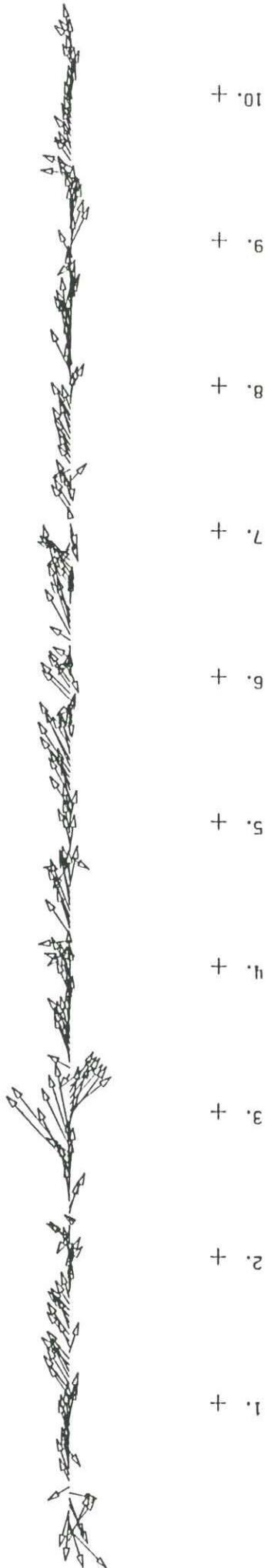


SEKİL. I. 11 CM 6687'deki (Nisan-Mayıs 1992) Tuzluluk ve sıcaklık

RCM 6625 22.4-12.5.1992

current velocity vector

vel scale: 1 cm = 20. cm/s.

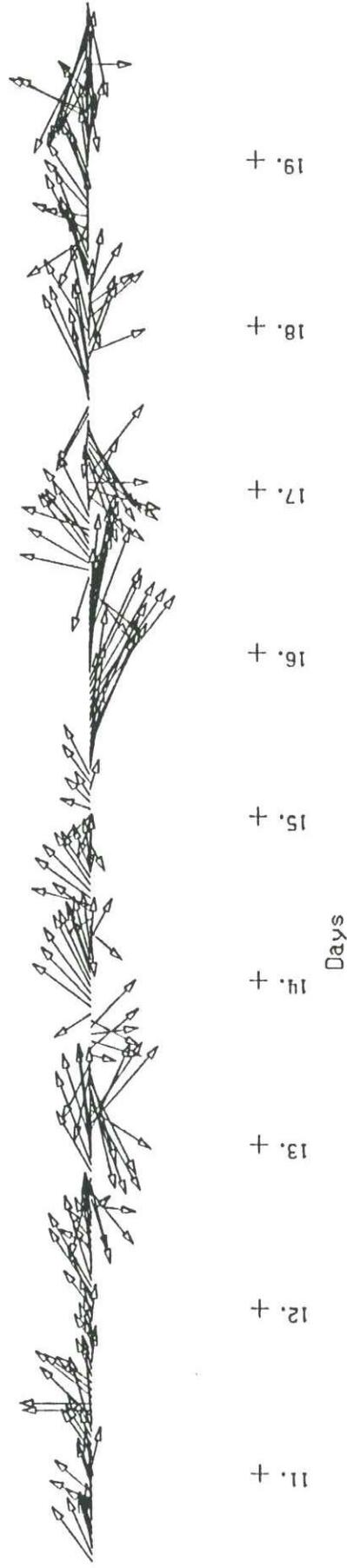
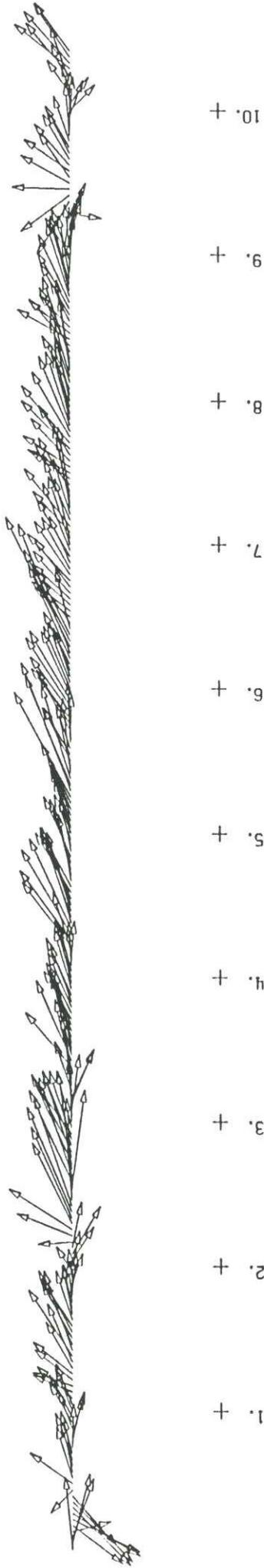


SEKİL. I. 12 Nisan-Mayıs 1992 akıntı hız vektörü

RCM 6687 22.4-12.5.1992

current velocity vector

vel scale: 1 cm = 20. cm/s.



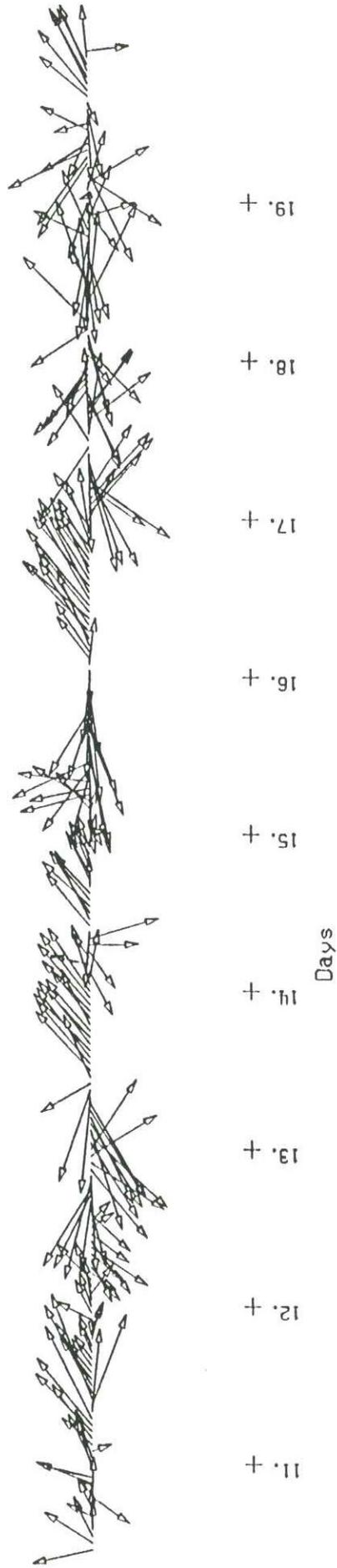
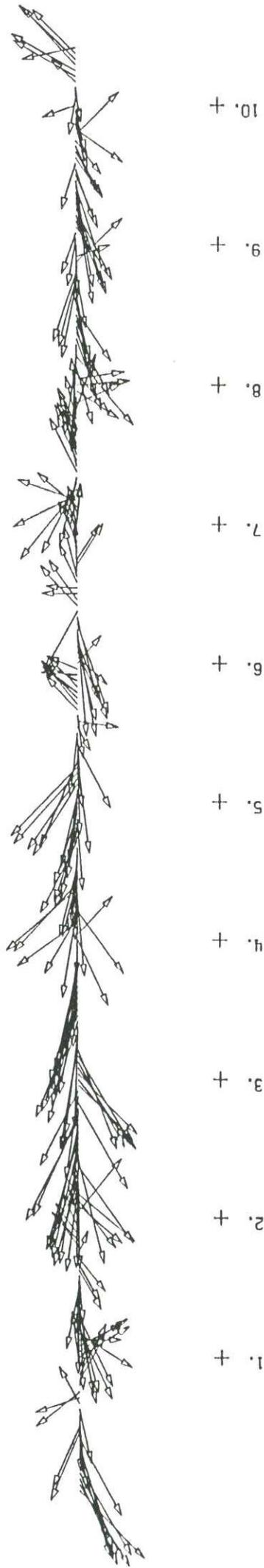
Days

SEKİL. I. 13 Nisan-Mayıs 1992 akıntı hız vektörü

RCM 4819 4819 22.4-12.5.1992

current velocity vector

vel scale: 1 cm = 20. cm/s.



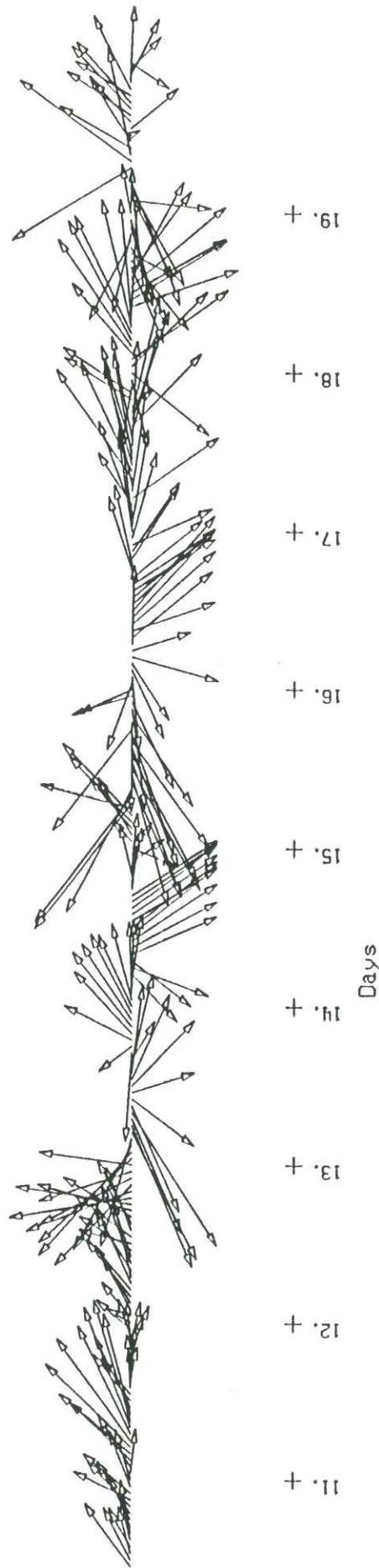
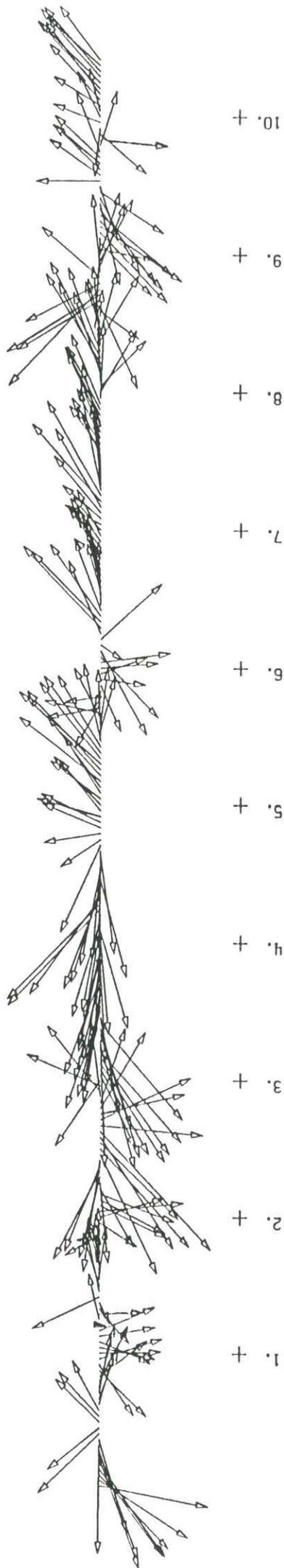
Days

SEKİL. I. 14 Nisan-Mayıs 1992 akıntı hız vektörü

RCM 2905 22.4-12.5.1992

current velocity vector

vel scale: 1 cm = 20. cm/s.



SEKİL. I. 15 Nisan-Mayıs 1992 akıntı hız vektörü

CM 6625 Apr 92

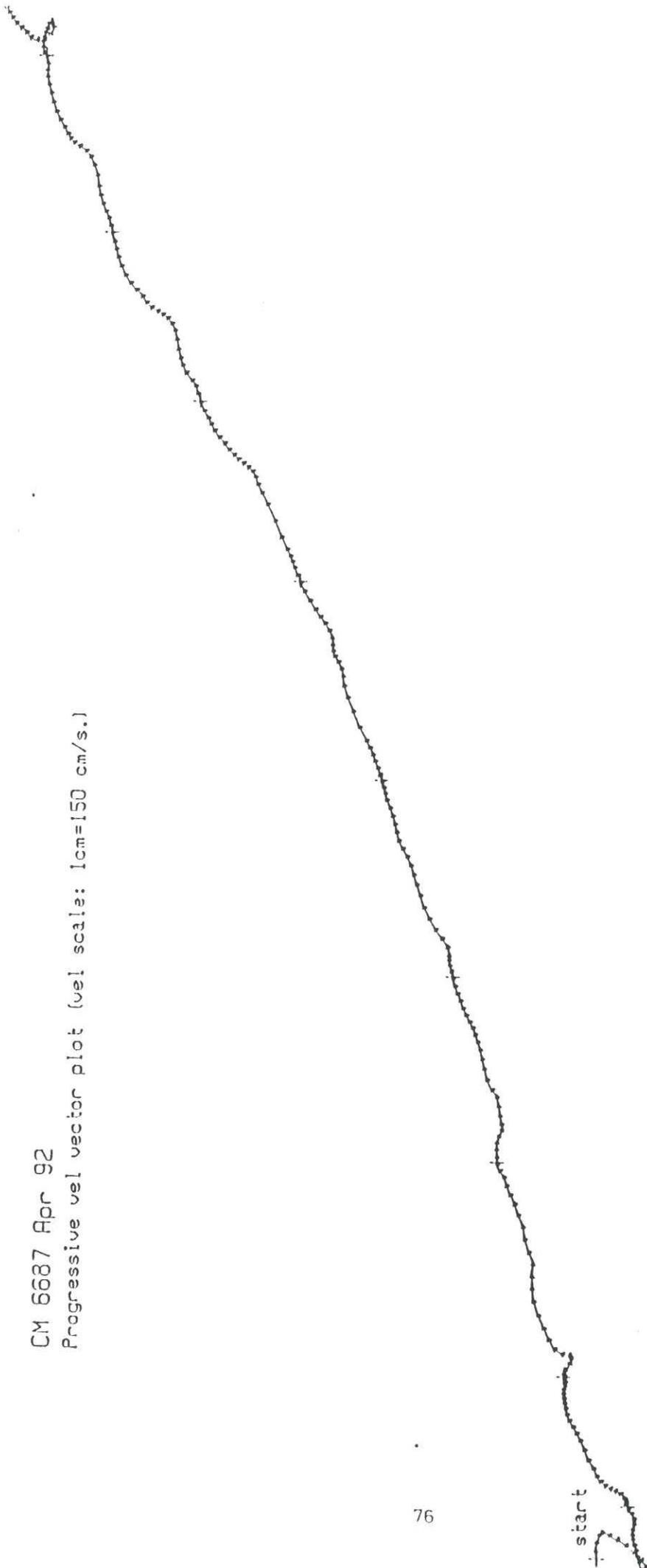
Progressive vel vector plot (vel scale: 1cm=150 cm/s.)



SEKİL. I. 16 CM 6625'deki vektor diagramları (Nisan-Mayıs 92)

CM 6687 Apr 92

Progressive vel vector plot (vel scale: 1cm=150 cm/s.)

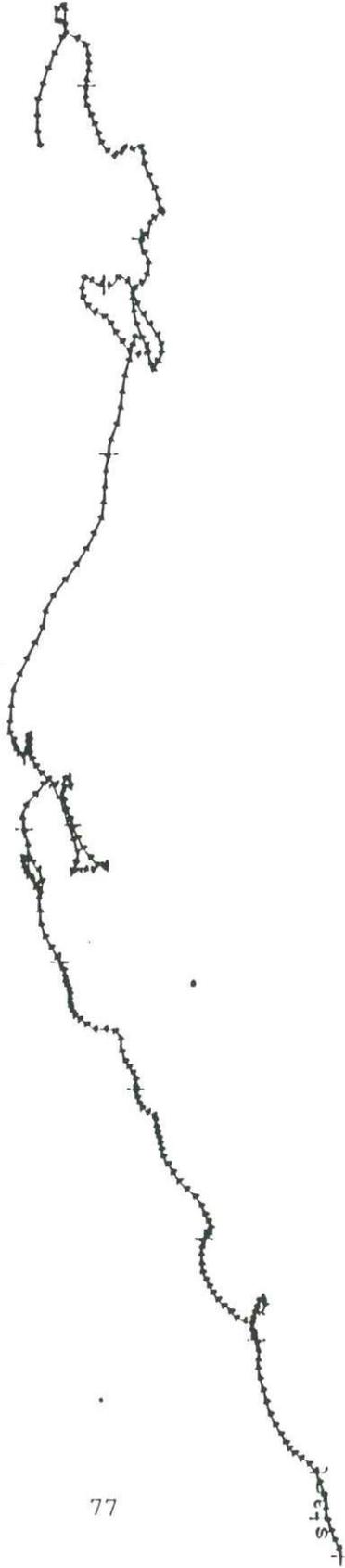


start

SEKİL. I. 17 CM 6687'deki vektor diagramları (Nisan-Mayıs 92)

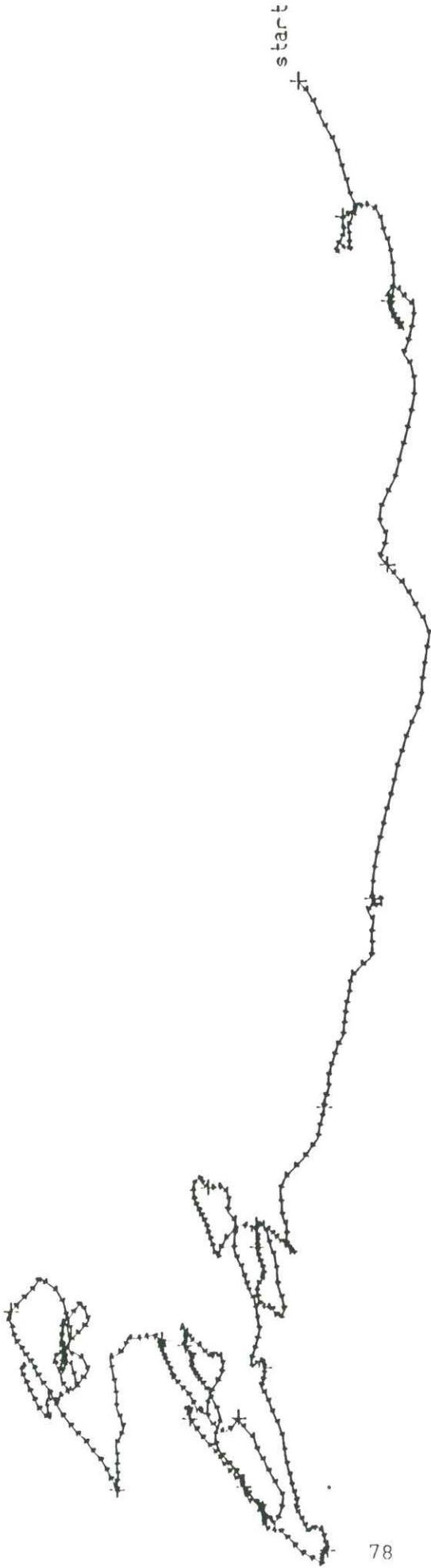
Cm 6687 Apr 92 (cont)

Progressive vel vector plot (vel scale: 1cm=150 cm/s.)



CM 4819 Apr 92

Progressive vel vector plot (vel scale: 1cm=150 cm/s.)



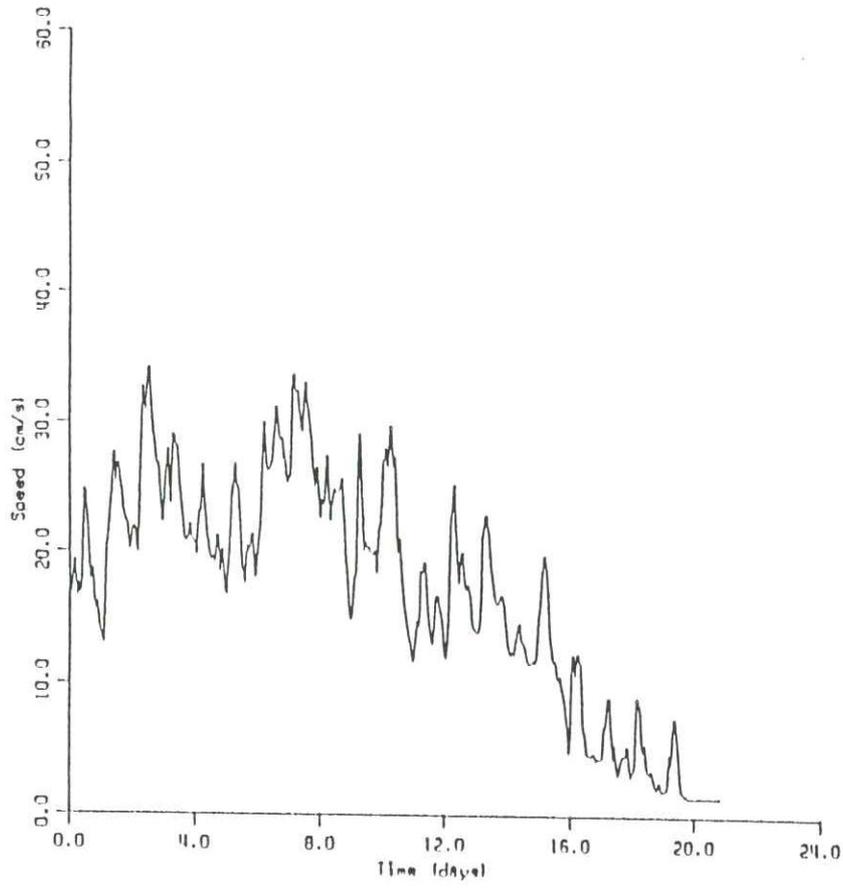
CM 2905 Apr 92

Progressive vel vector plot (vel scale: 1cm=150 cm/s.)

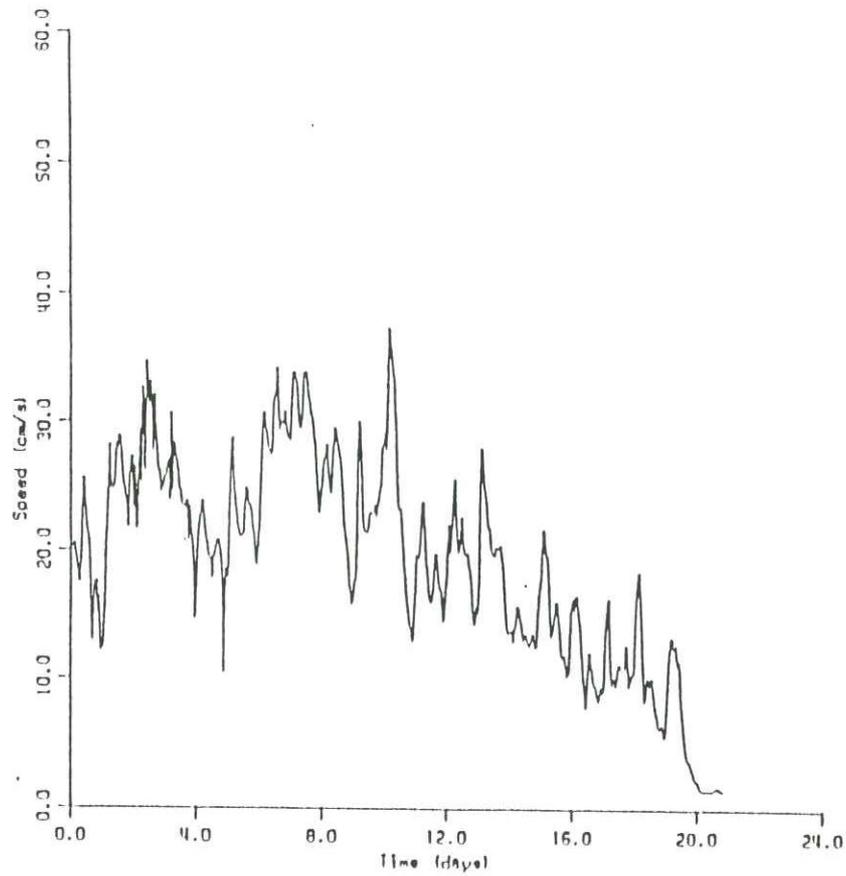


SEKİL. I.19 CM 2905'deki vektor diagramları (Nisan-Mayıs 92)

NCH 6625 July 92



NCH 2905 July 92

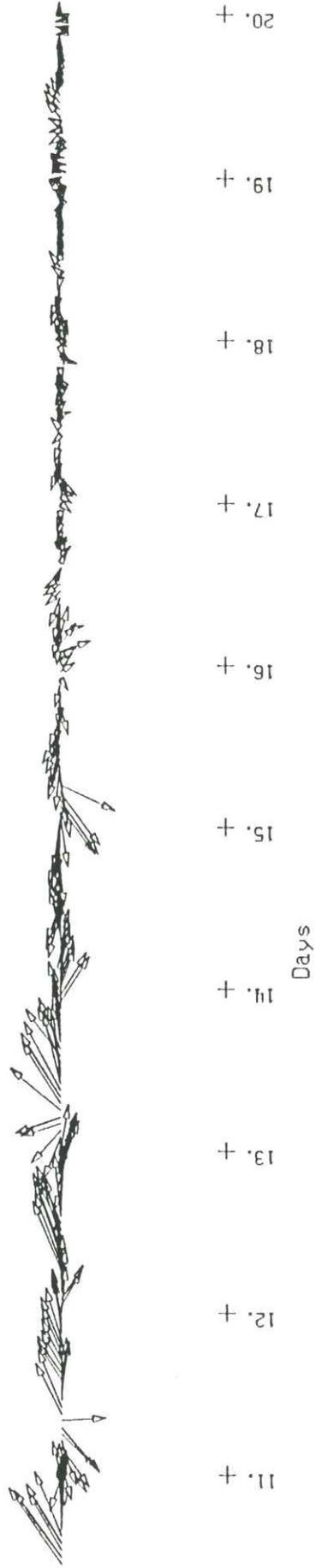
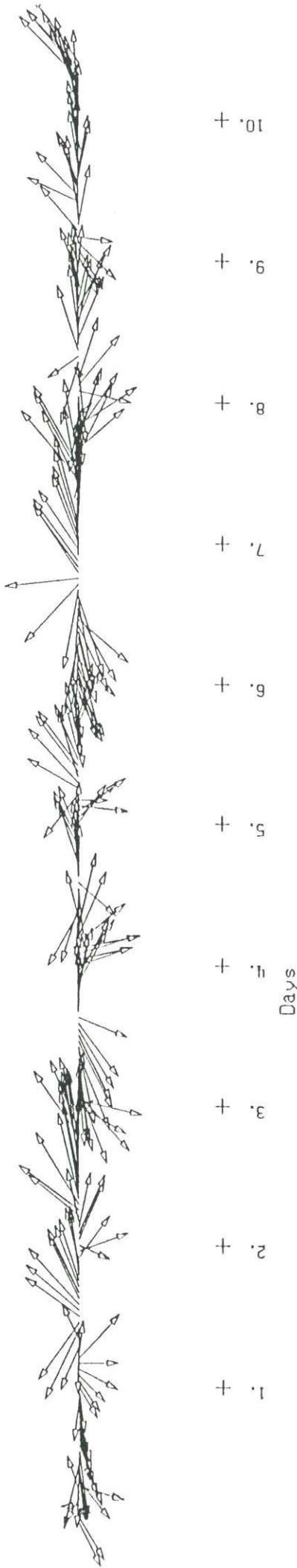


SEKİL. I.20 Akıntı hızı zaman seri serileri (Temmuz-Agustos 92)

RCM 6625 22.7-11.8.1992

current velocity vector

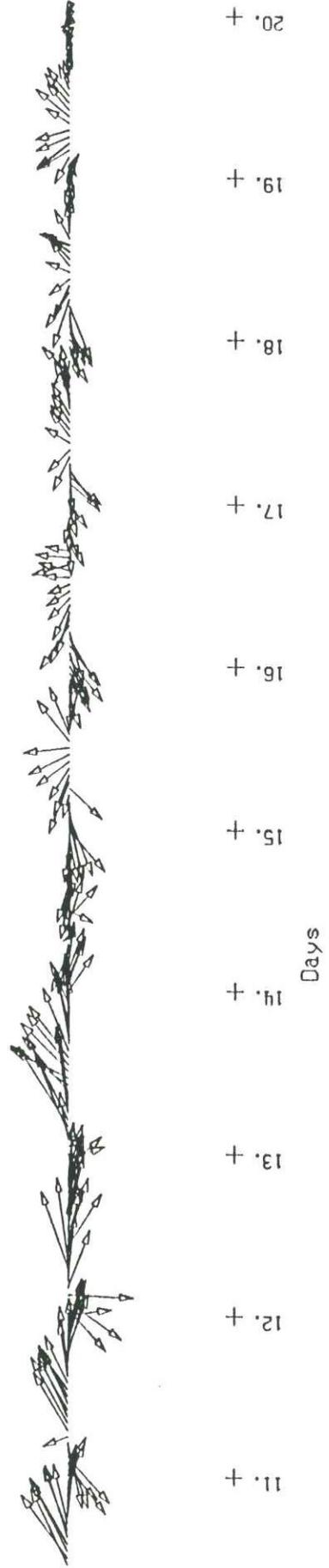
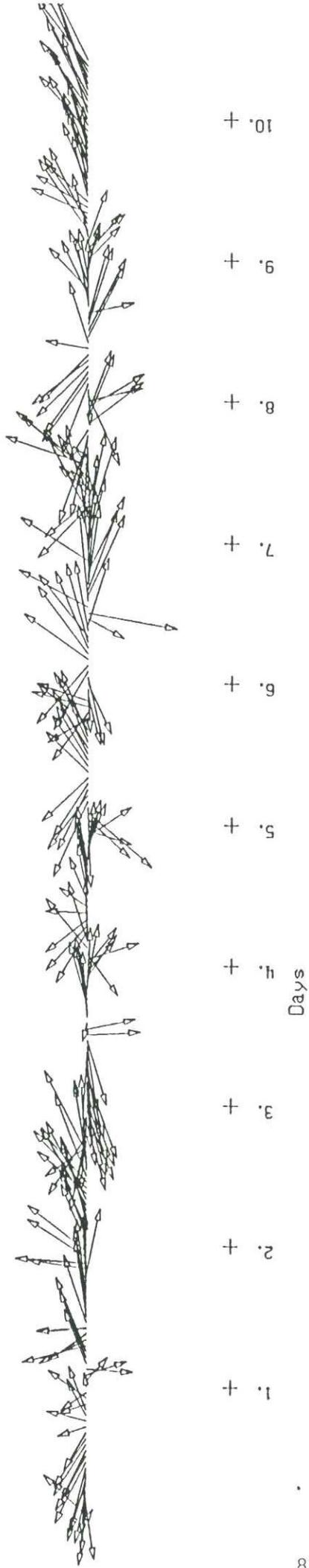
vel scale: 1 cm = 20. cm/s.



SEKIL. I. 21 Temmuz-Agustos akıntı hızı vektorleri

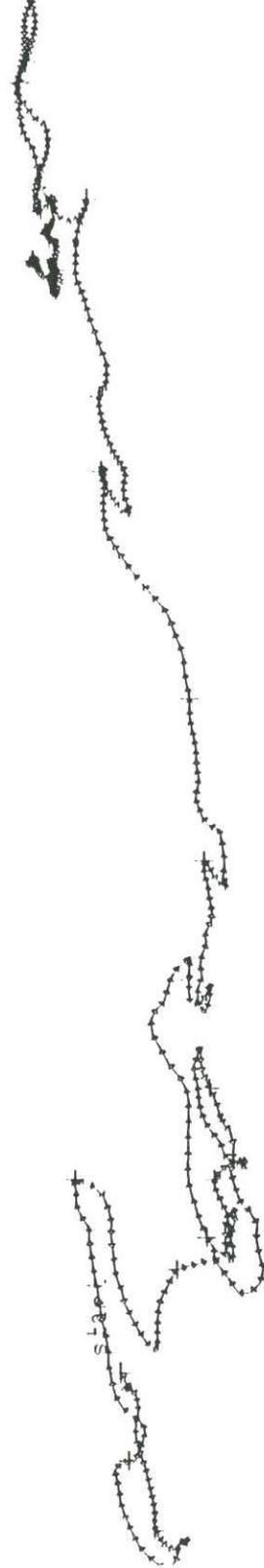
current velocity vector RCM 2905 22.7-11.8.1992

vel scale: 1 cm = 20. cm/s.



SEKIL. I. 22 Temmuz-Agustos akıntı hızı vektorleri

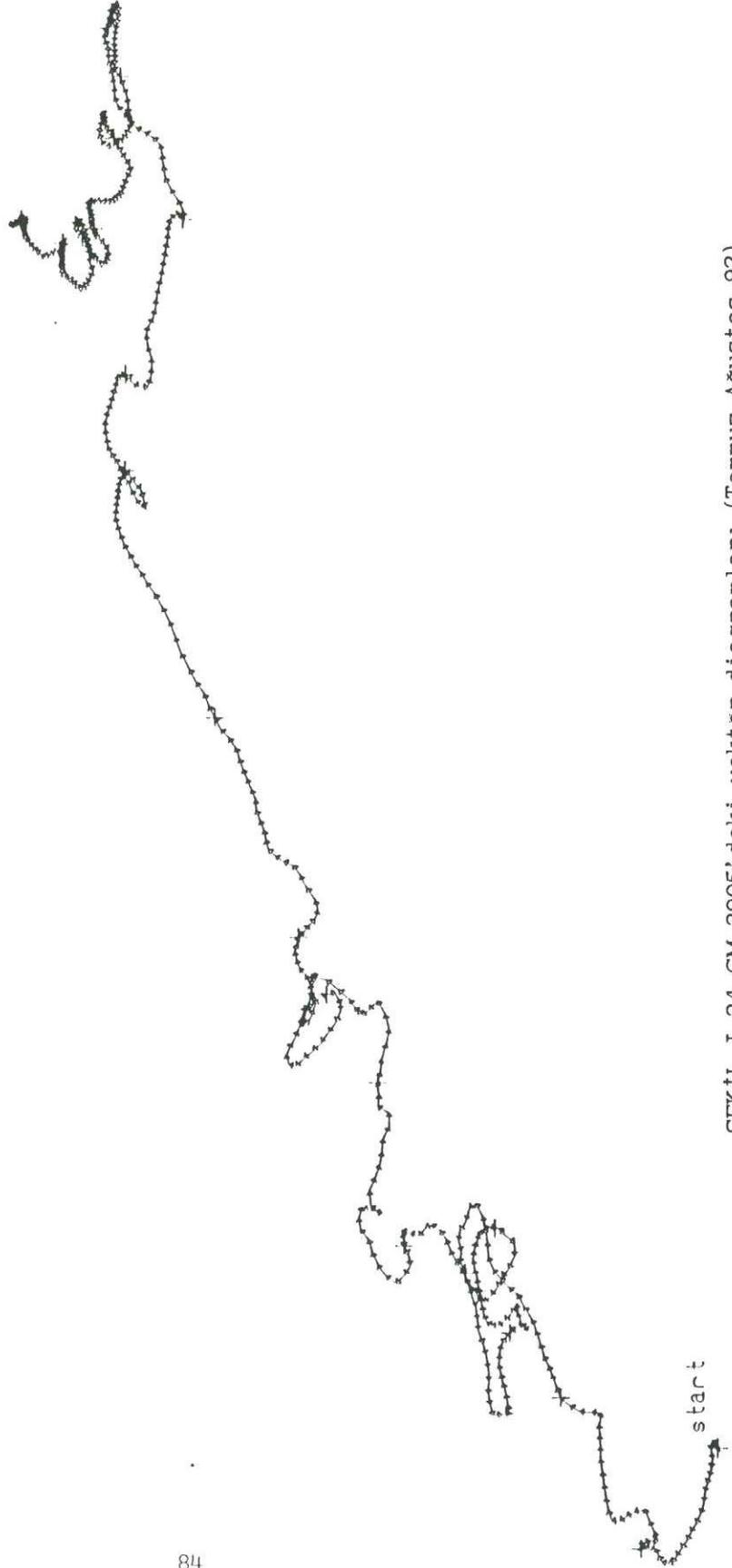
CM 6625 July 92
Progressive vel vector plot (vel scale: 1cm=150 cm/s.)



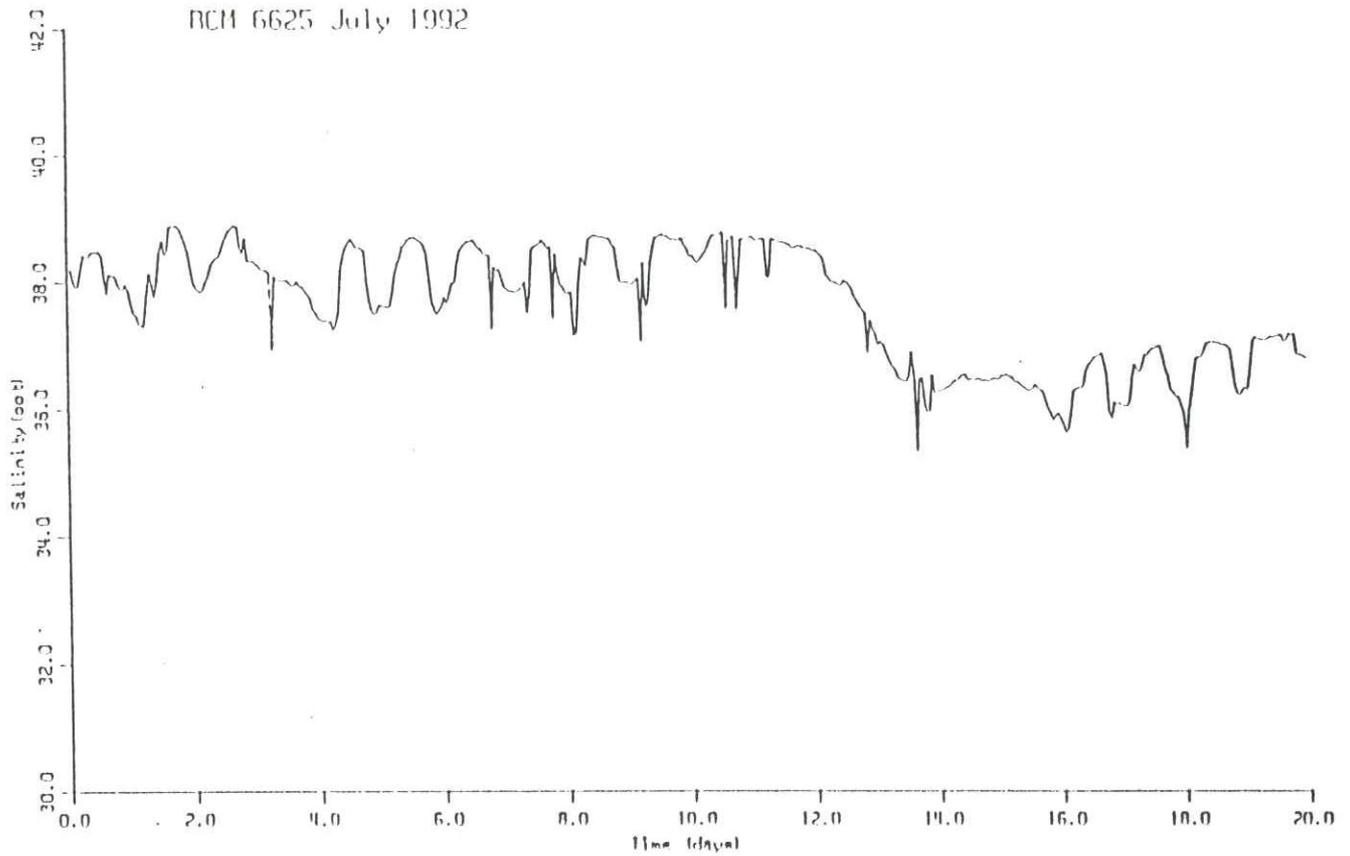
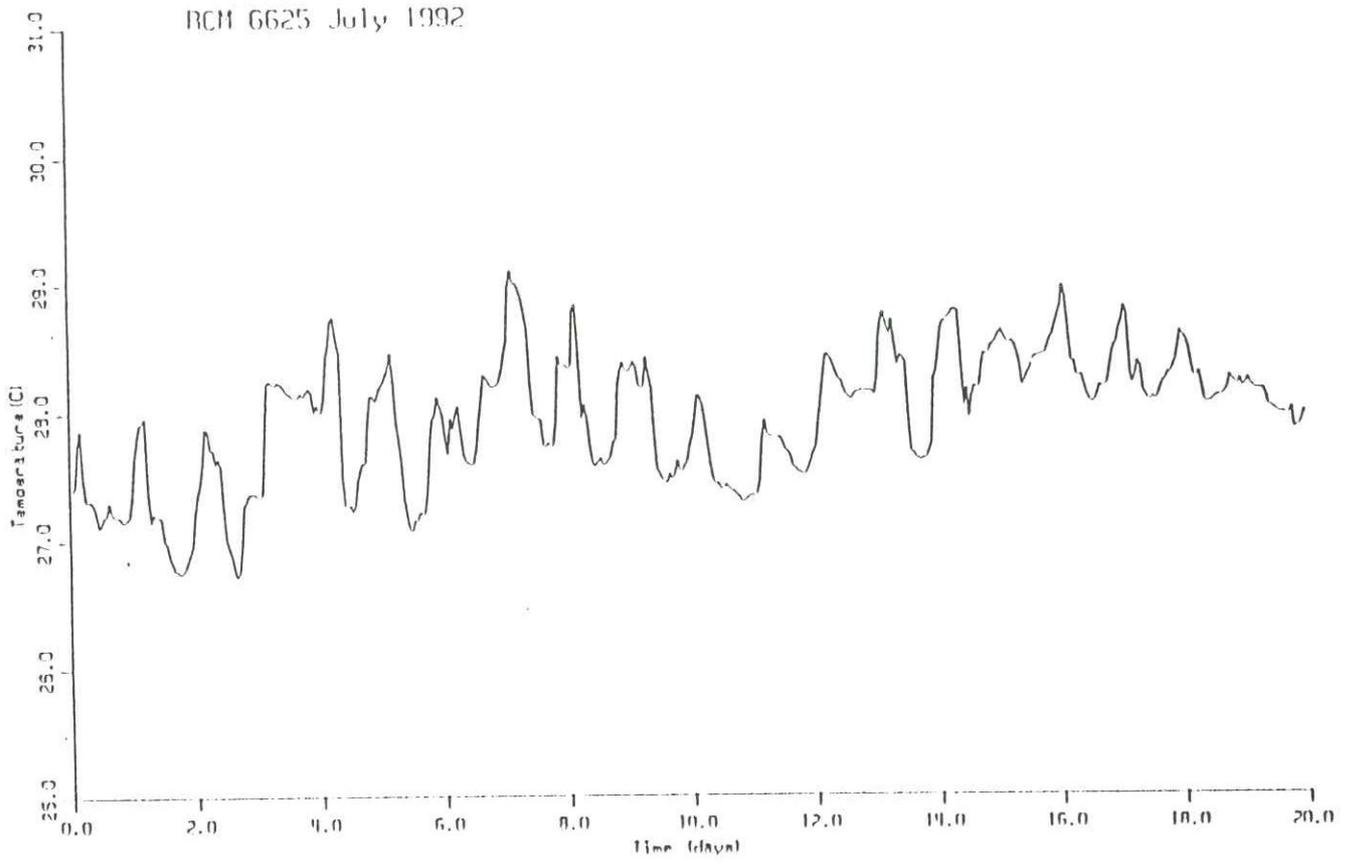
SEKİL. I.23 CM 6625'deki vektor diagramları (Temmuz-Agustos 92)

CM 2905 July 92

Progressive vel vector plot (vel scale: 1cm=150 cm/s.)

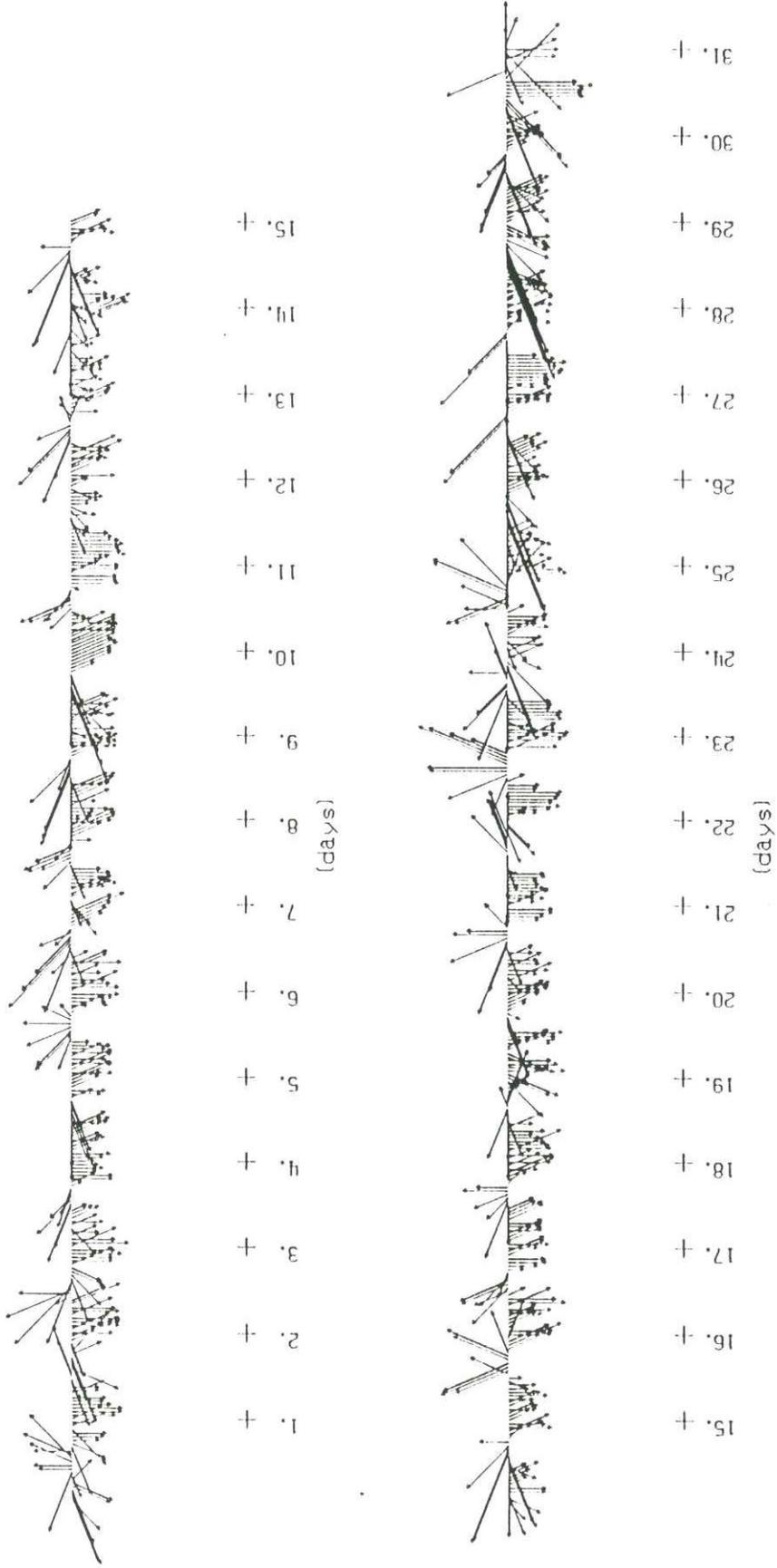


SEKIL. I. 24 CM 2905'deki vektor diagramlari (Temmuz-Agustos 92)



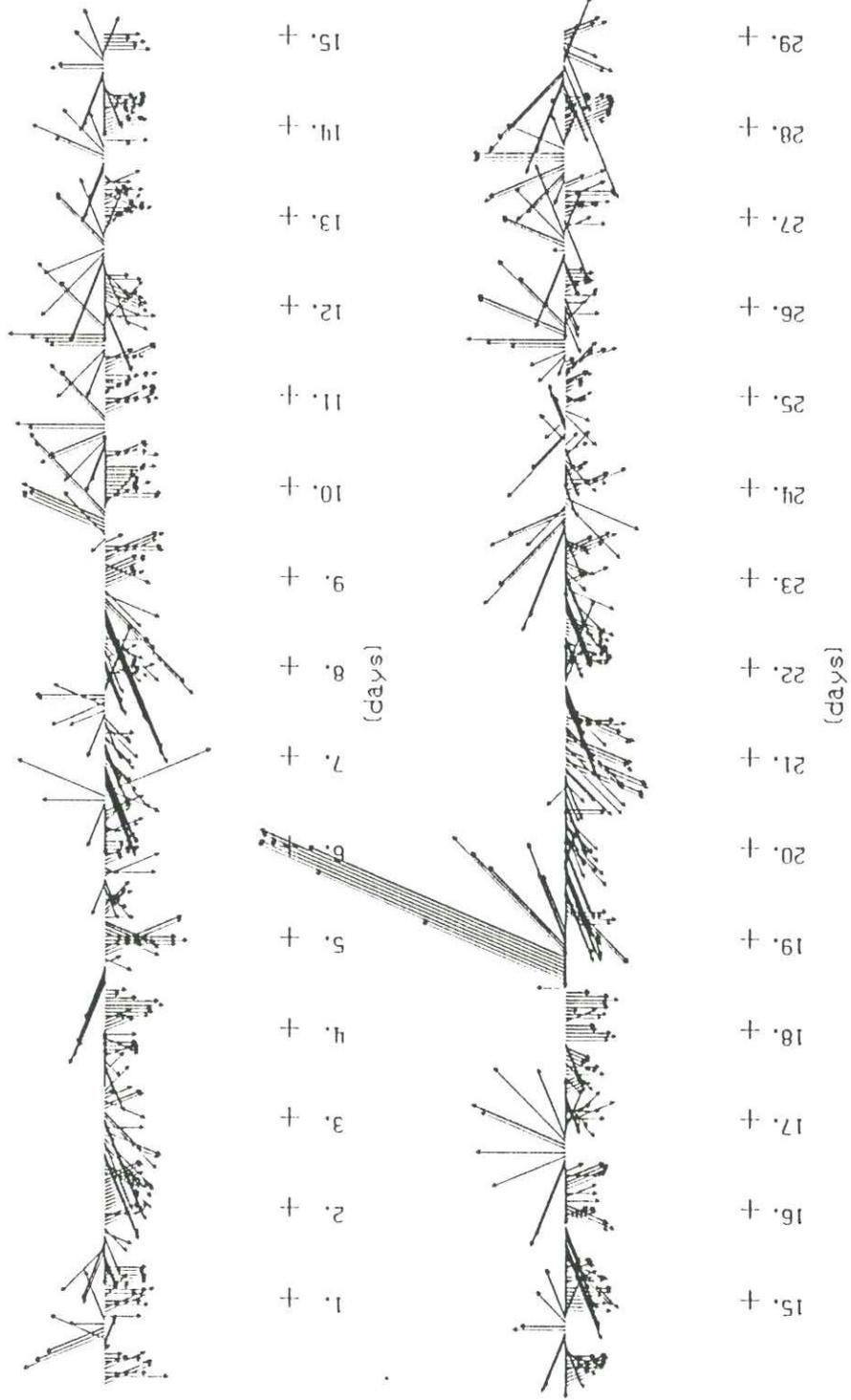
SEKİL. I. 25 CM 6625'deki ((Temmuz-Agustos 1992) Tuzluluk ve sıcaklık

Mersin wind Jan 1992
vel scale: 1 cm = 3. m/s.



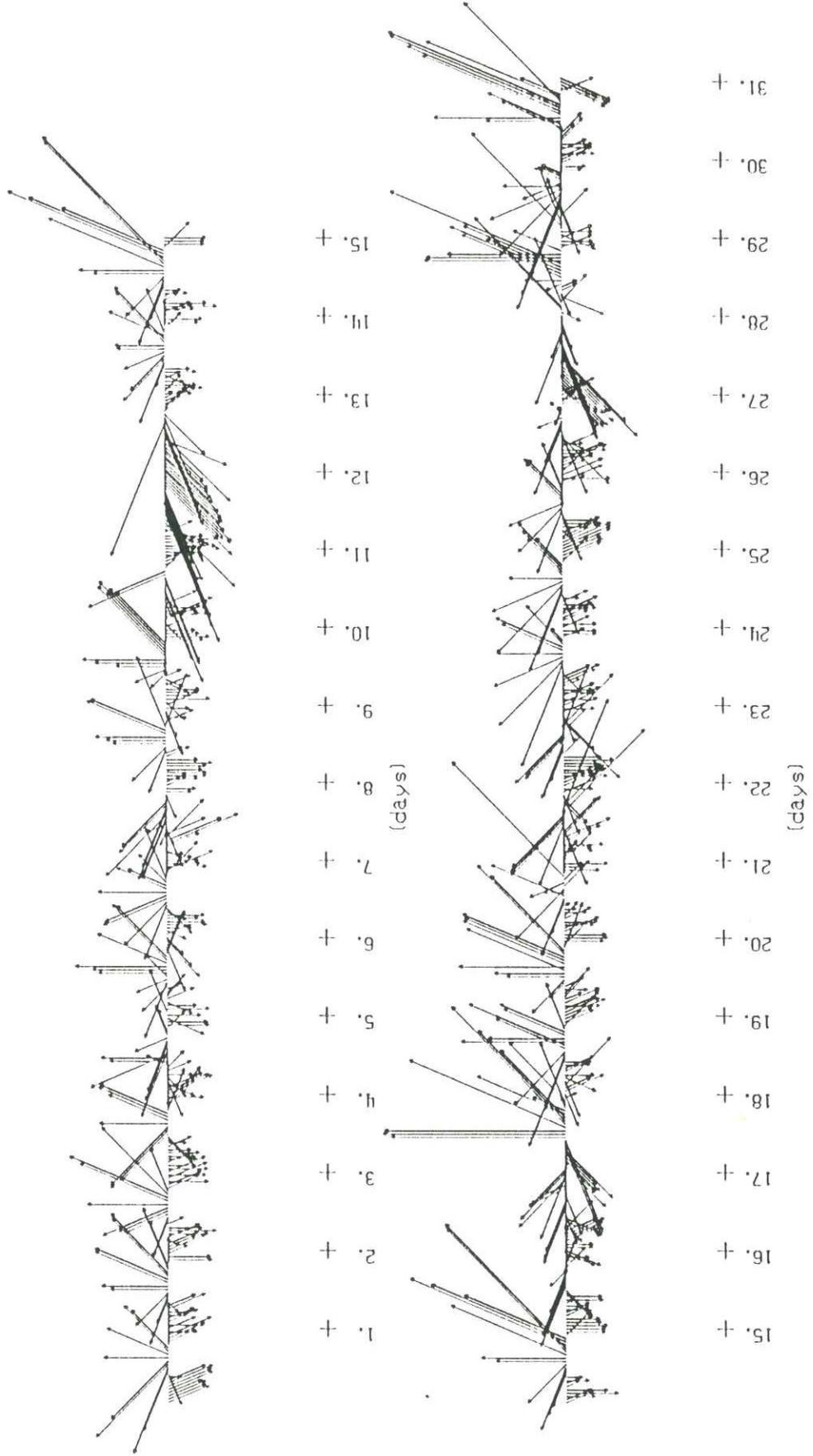
ŞEKİL. I.26 Mersin rüzgar hızı vektörleri

Mersin wind Feb 1992
vel scale: 1 cm = 3. m/s.



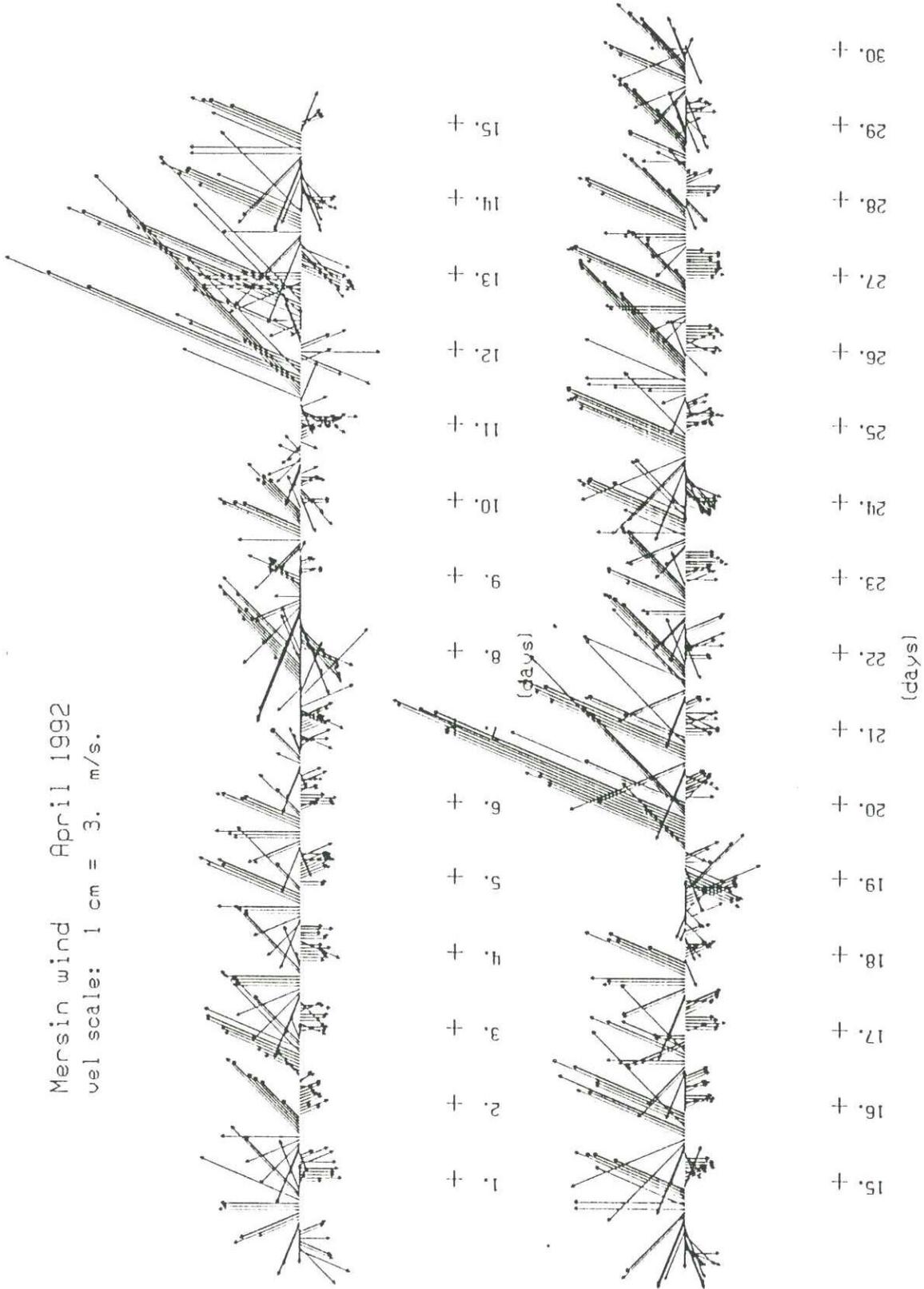
SEKİL. I.26 Mersin rüzgar hızı vektörleri

Mersin wind March 1992
vel scale: 1 cm = 3. m/s.



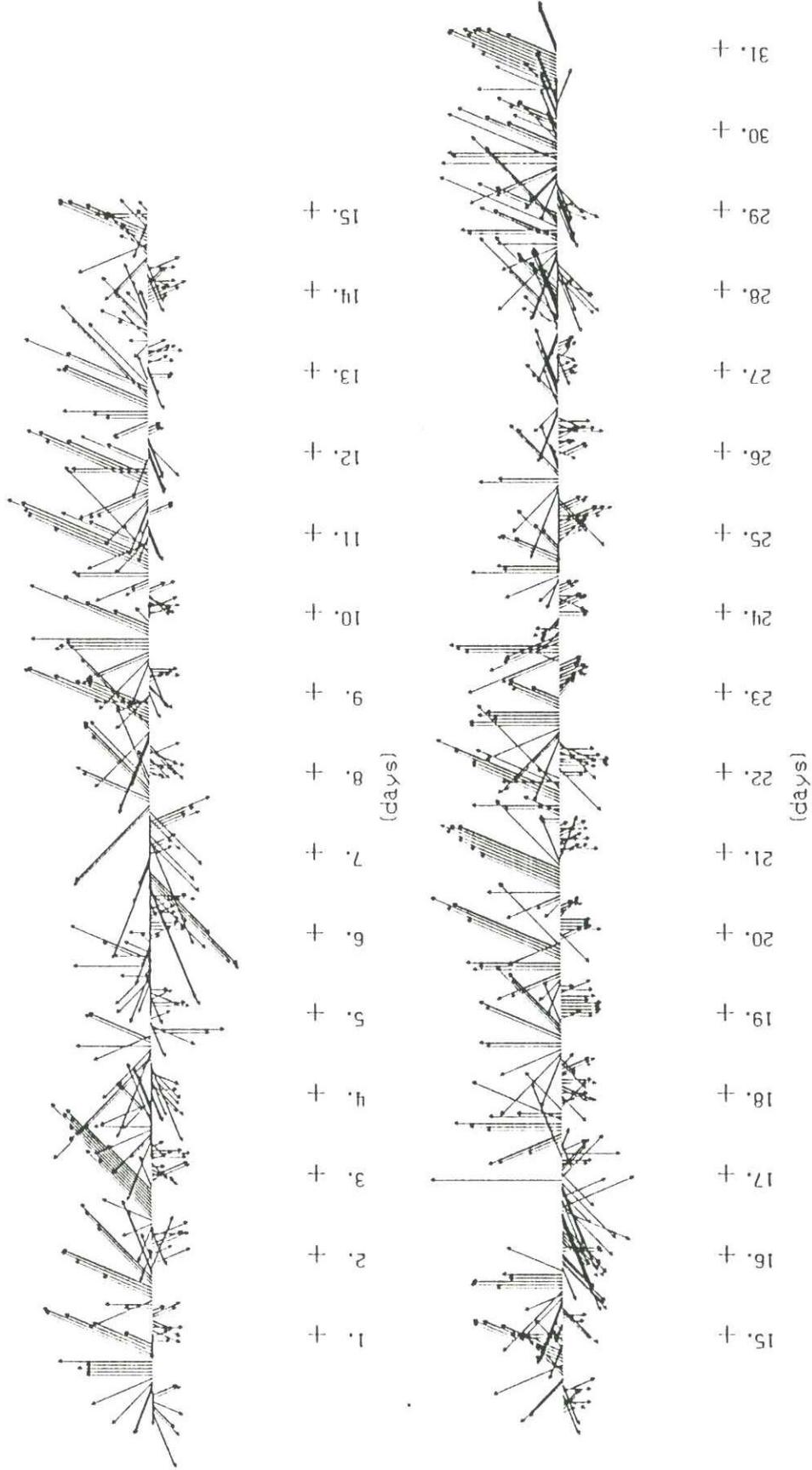
SEKİL. I.26 Mersin rüzgar hızı vektörleri

Mersin wind April 1992
vel scale: 1 cm = 3. m/s.



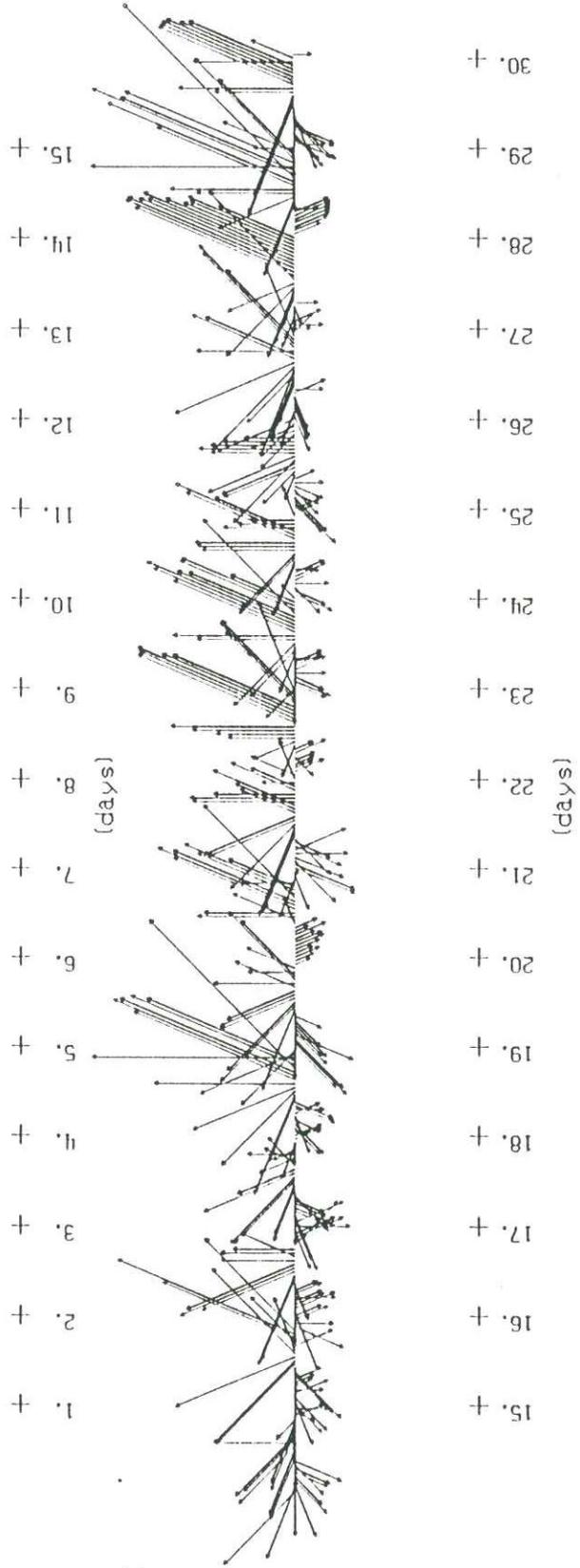
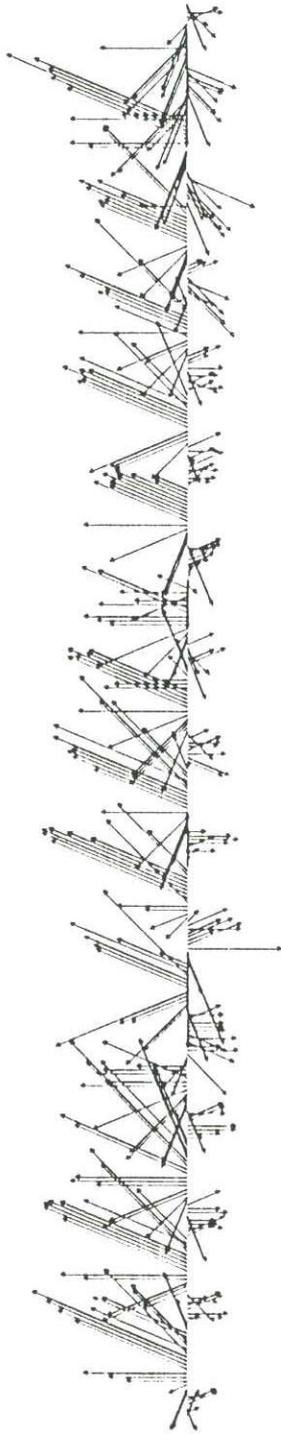
SEKİL. I.26 Mersin ruzgar hızı vektorleri

Mersin wind May 1992
vel scale: 1 cm = 3. m/s.



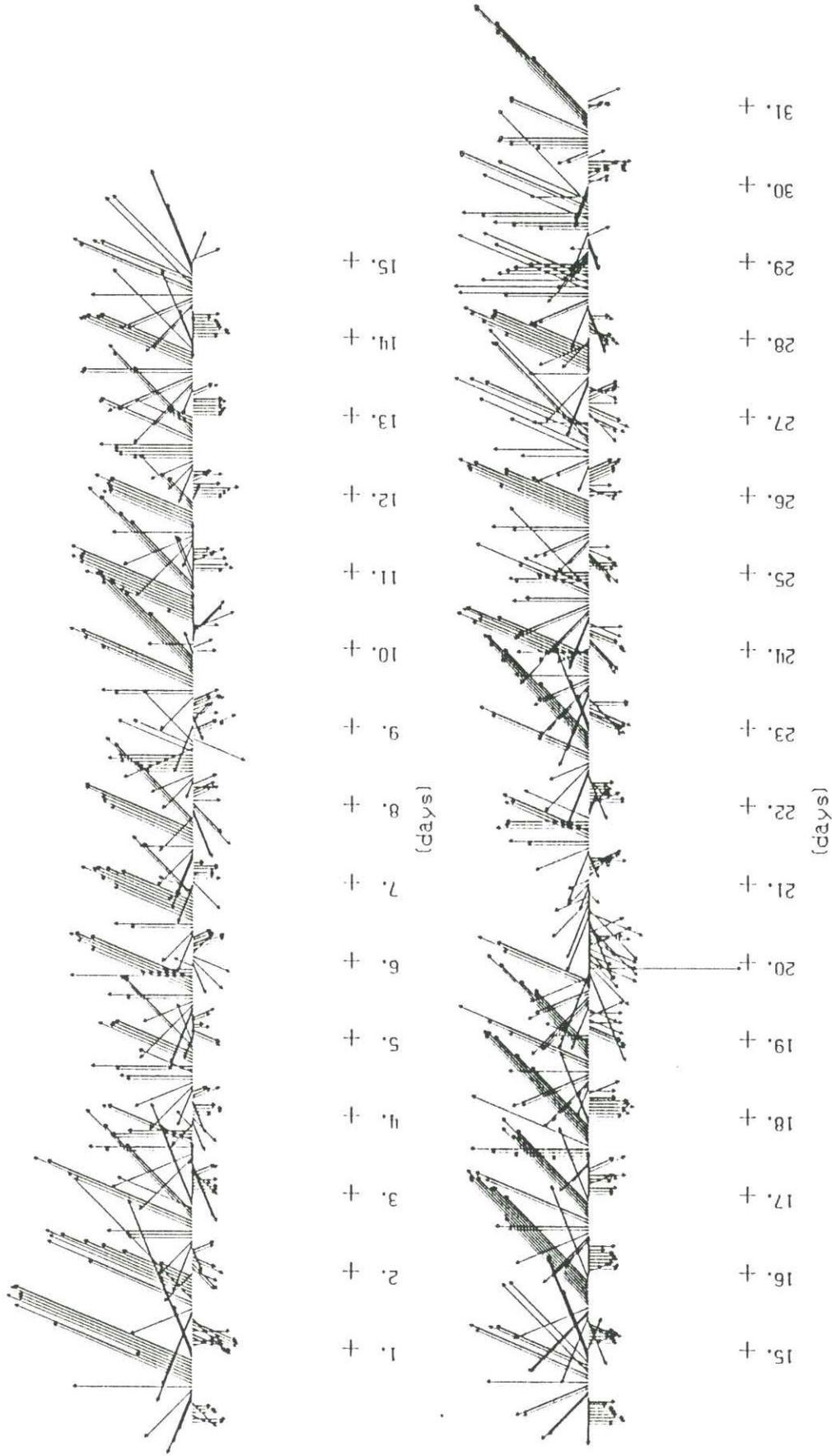
SEKİL. I.26 Mersin rüzgar hızı vektörleri

Mersin wind June 1992
vel scale: 1 cm = 3. m/s.



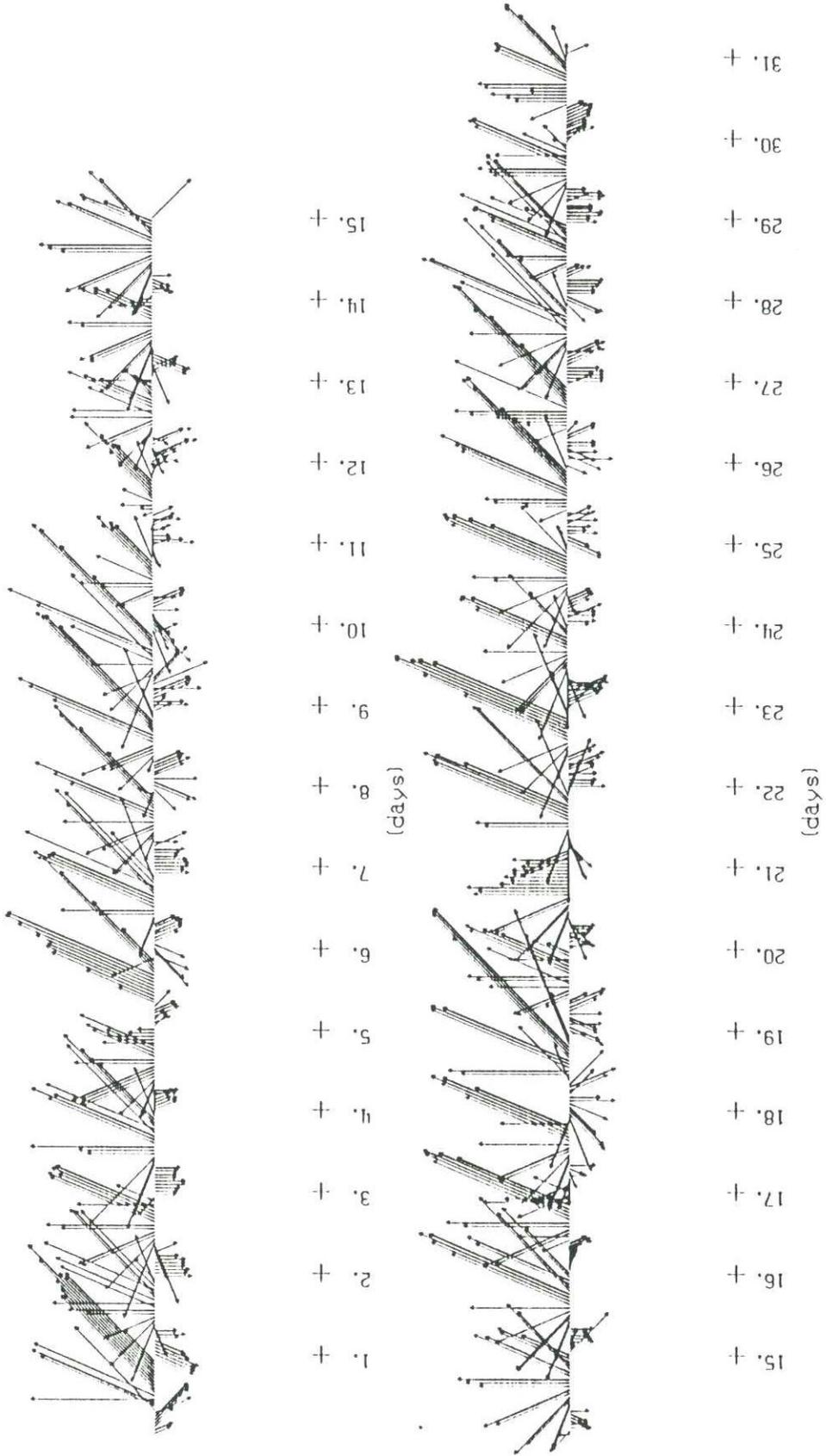
SEKİL. I.26 Mersin rüzgar hızı vektorleri

Mersin wind July 1992
vel scale: 1 cm = 3. m/s.



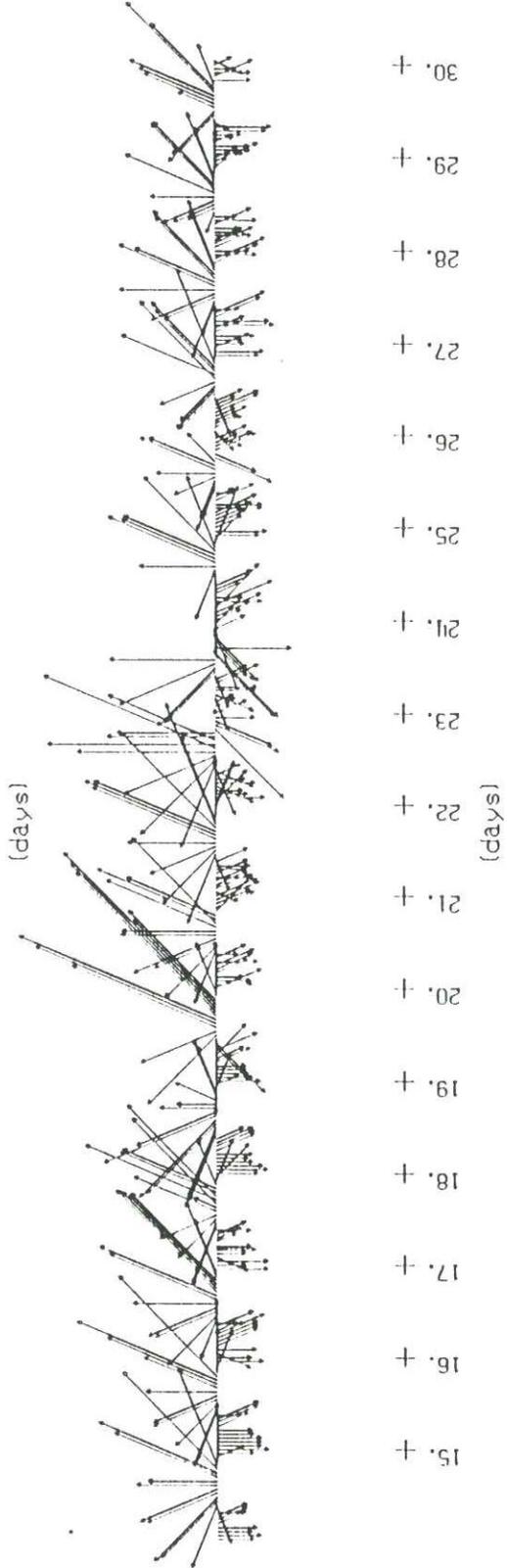
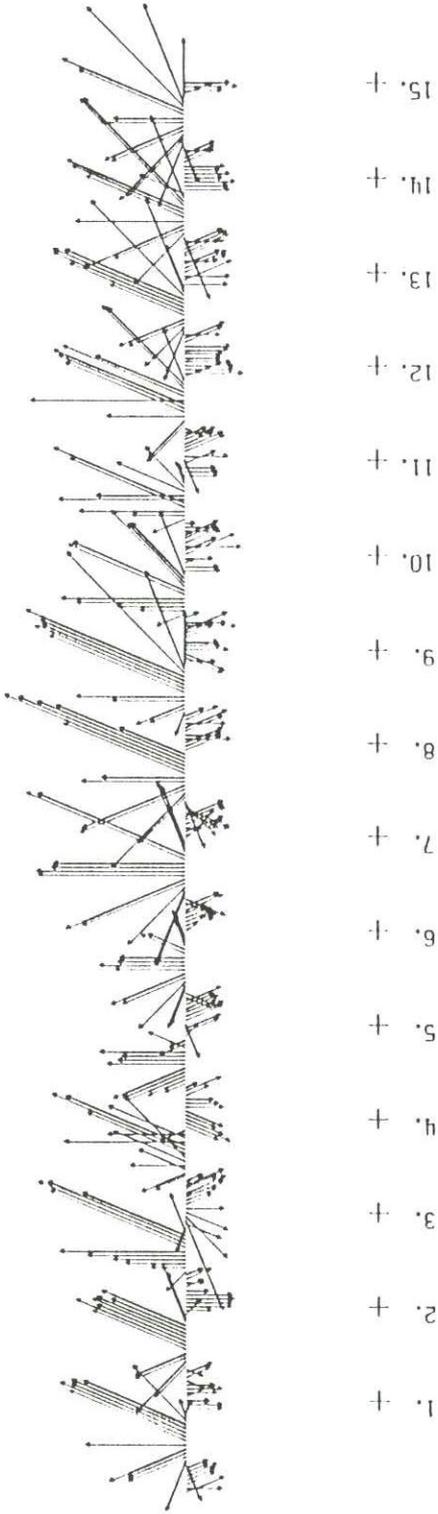
SEKİL. I. 26 Mersin rüzgar hızı vektorleri

Mersin wind Aug 1992
vel scale: 1 cm = 3. m/s.



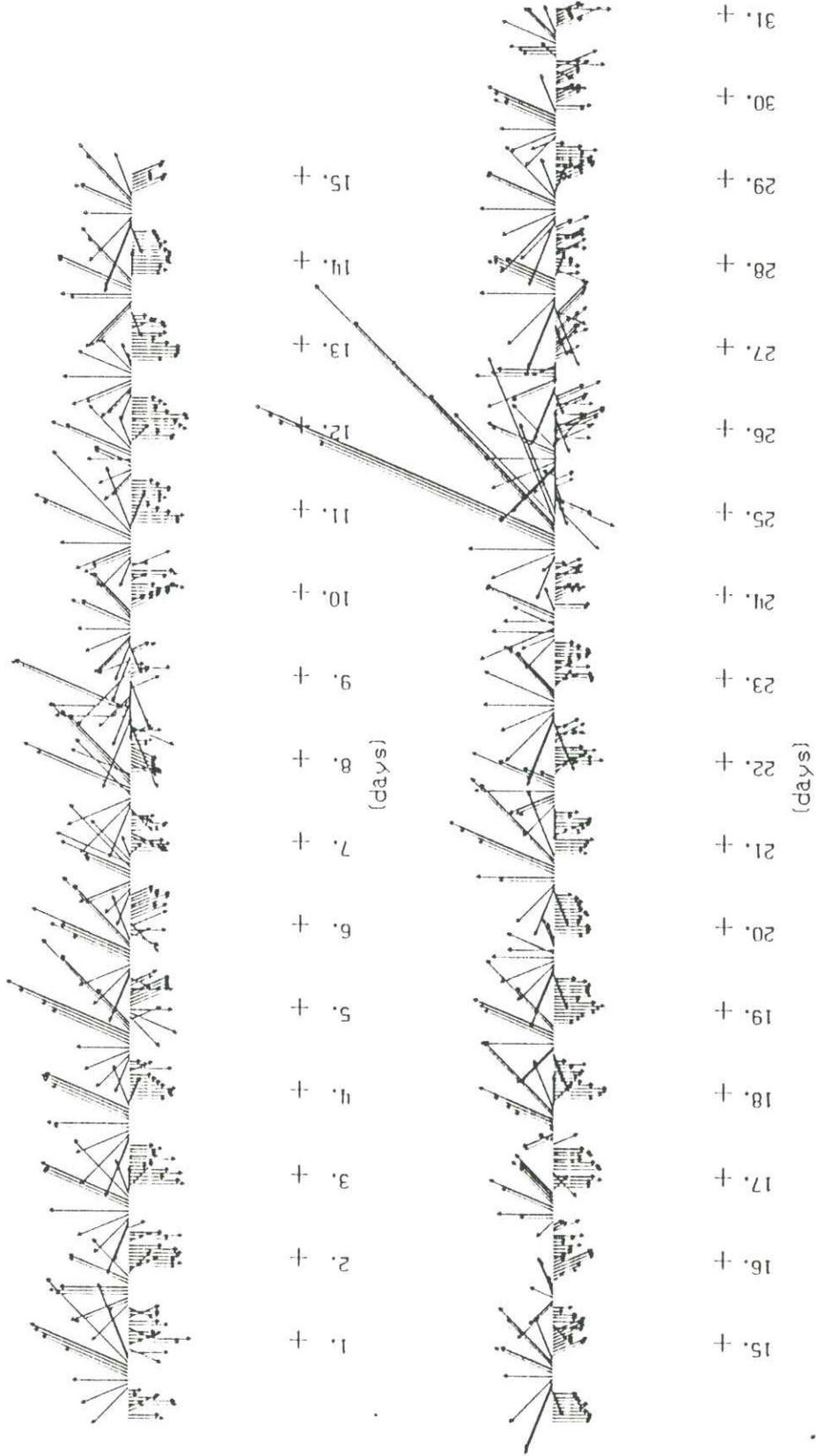
SEKİL. I.26 Mersin rüzgar hızı vektörleri

Mersin wind Sep 1992
vel scale: 1 cm = 3. m/s.

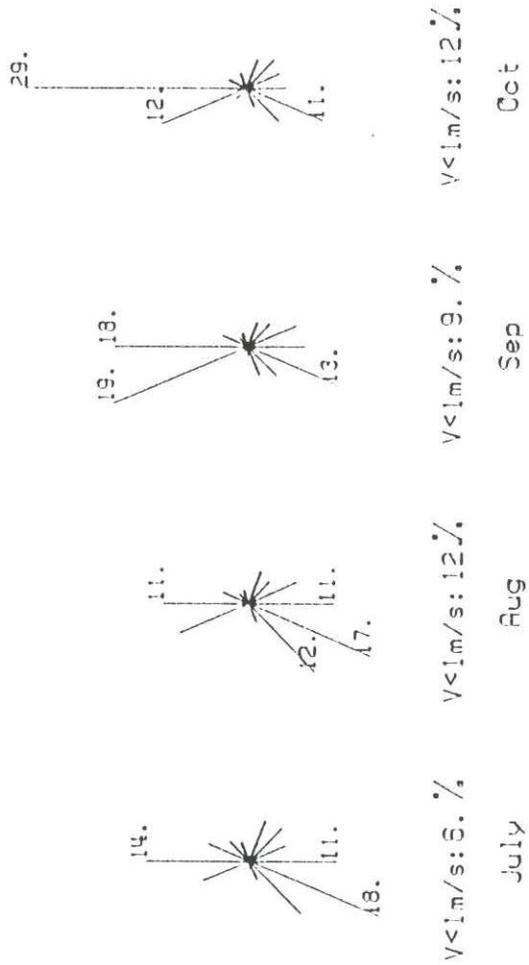
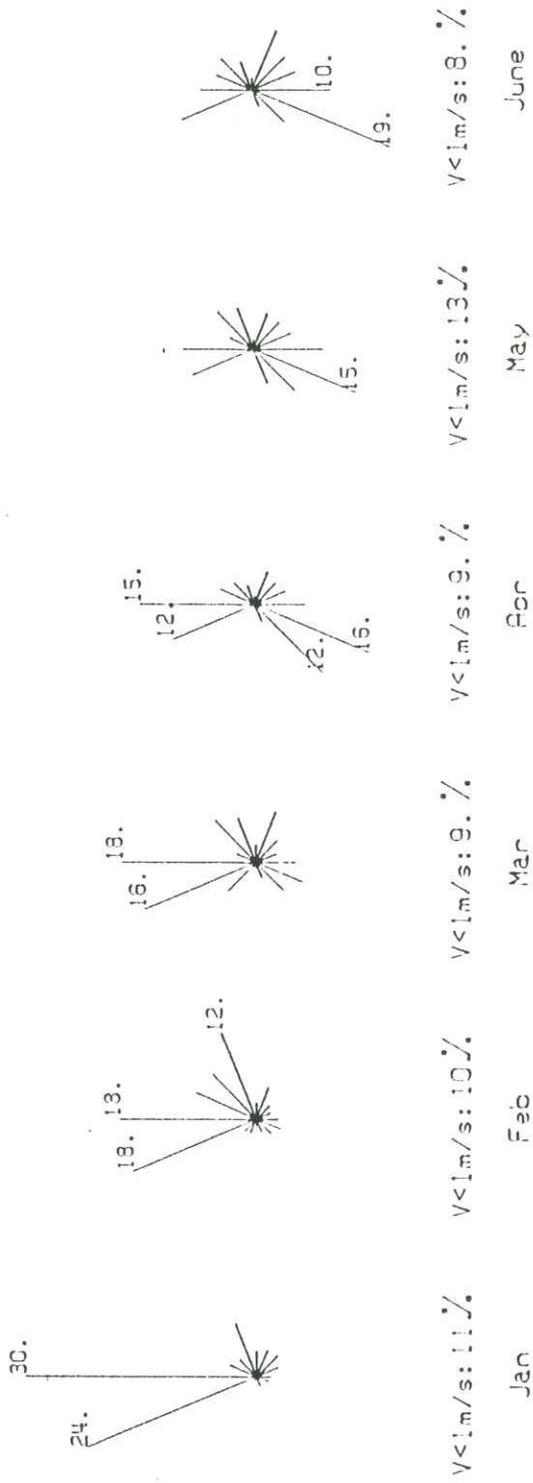


SEKİL. I.26 Mersin rüzgar hızı vektörleri

Mersin wind Oct 1992
vel scale: 1 cm = 3. m/s.



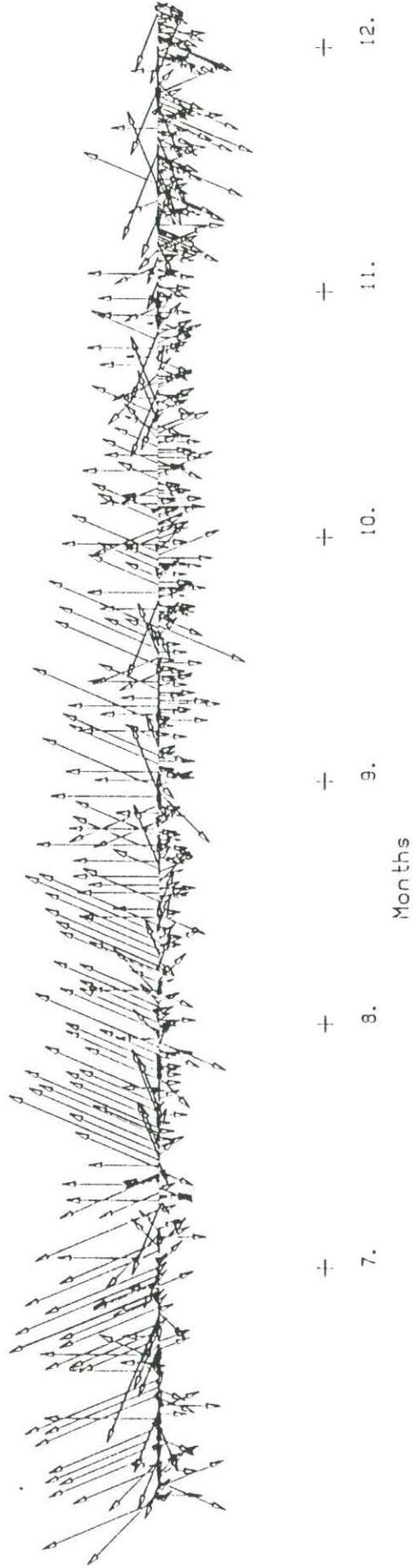
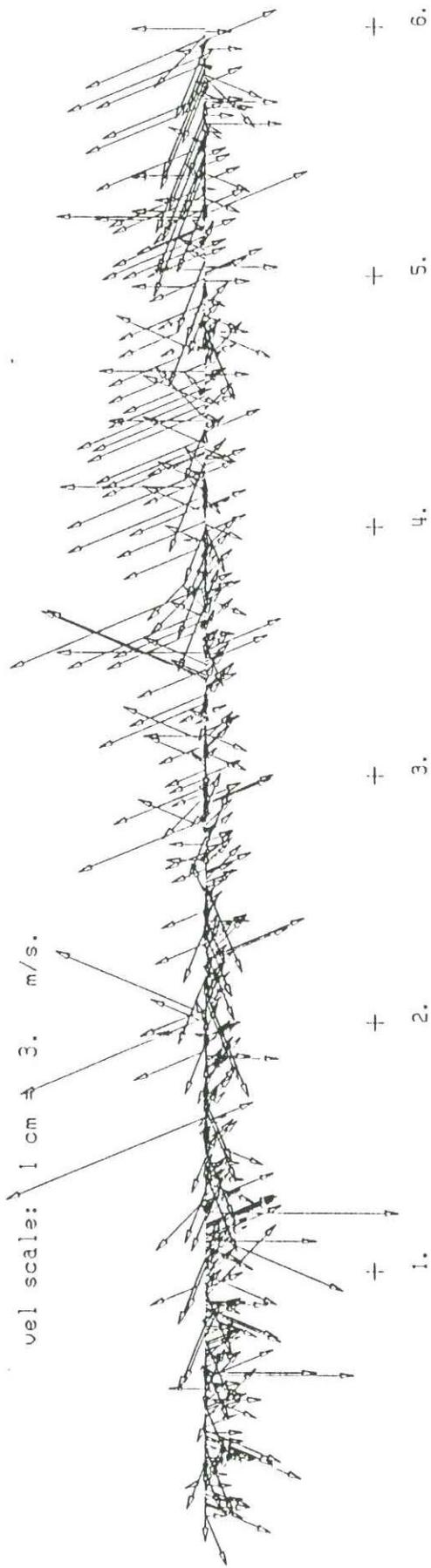
SEKİL. I. 26 Mersin rüzgar hızı vektörleri



1992 monthly wind frequency

SEKİL. I.27 Ruzgar frekansları

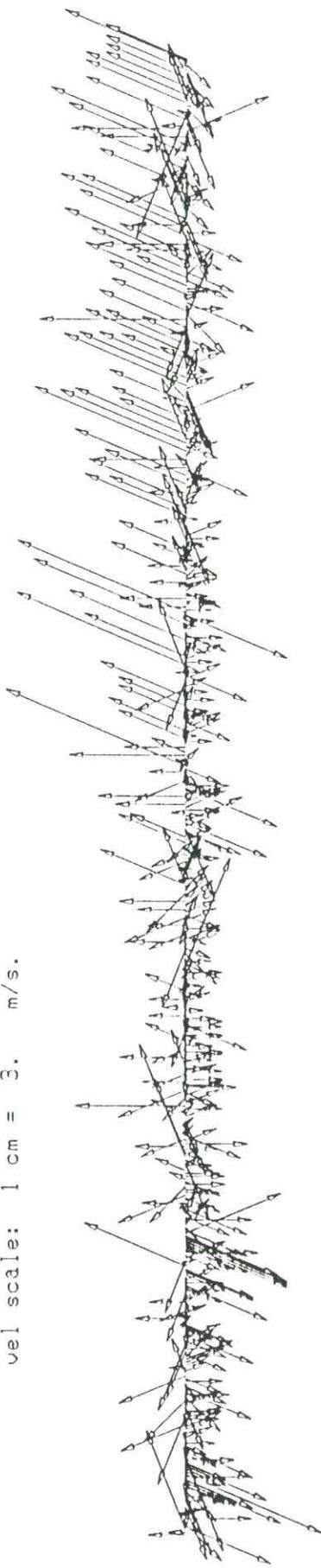
Mersin wind velocity vector 1977



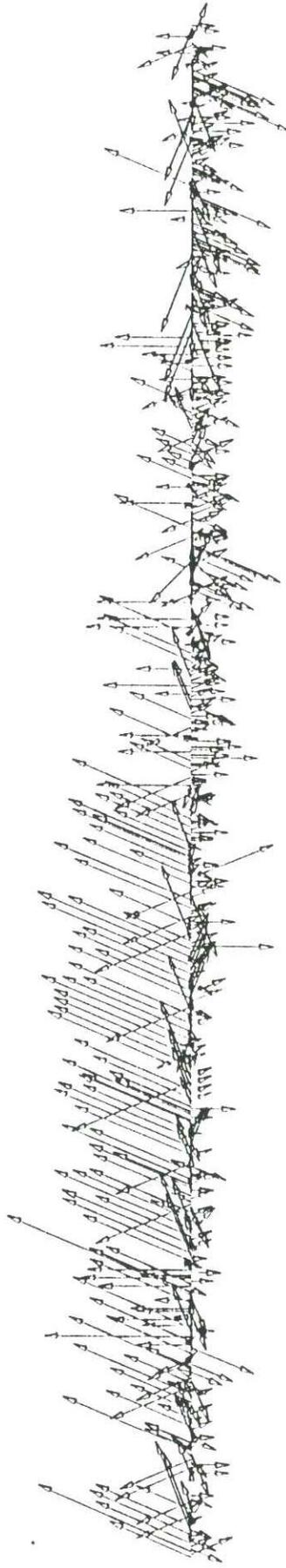
SEKİL. I.28 Mersin rüzgar hızı vektörleri 1977

Mersin wind velocity vector 1978

vel scale: 1 cm = 3. m/s.



+ 1. 2. 3. 4. 5. 6.

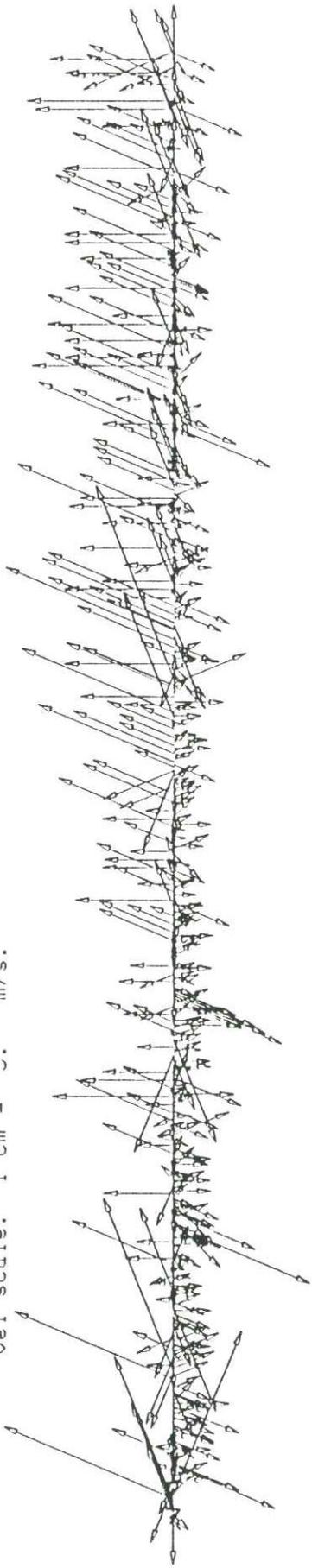


+ 7. 8. 9. 10. 11. 12.
Months

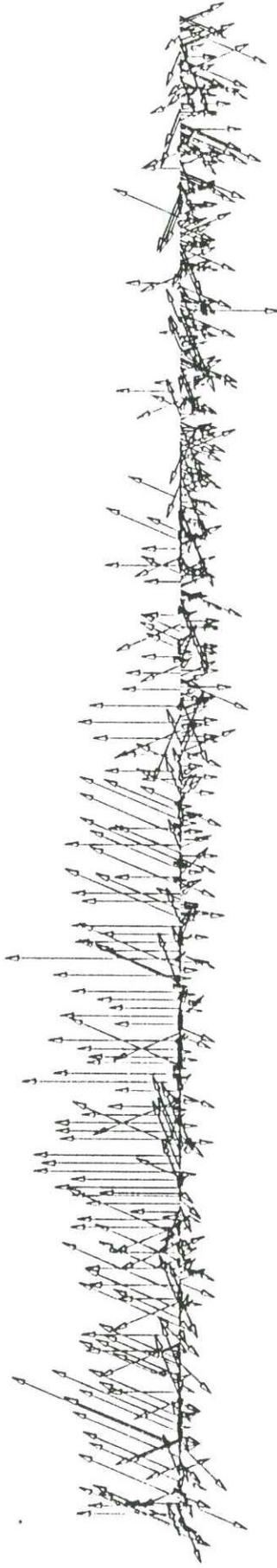
SEKİL. I.29 Mersin rüzgar hızı vektorleri 1978

Mersin wind velocity vector 1979

vel scale: 1 cm = 3. m/s.



+ 1. 2. 3. 4. 5. 6. +



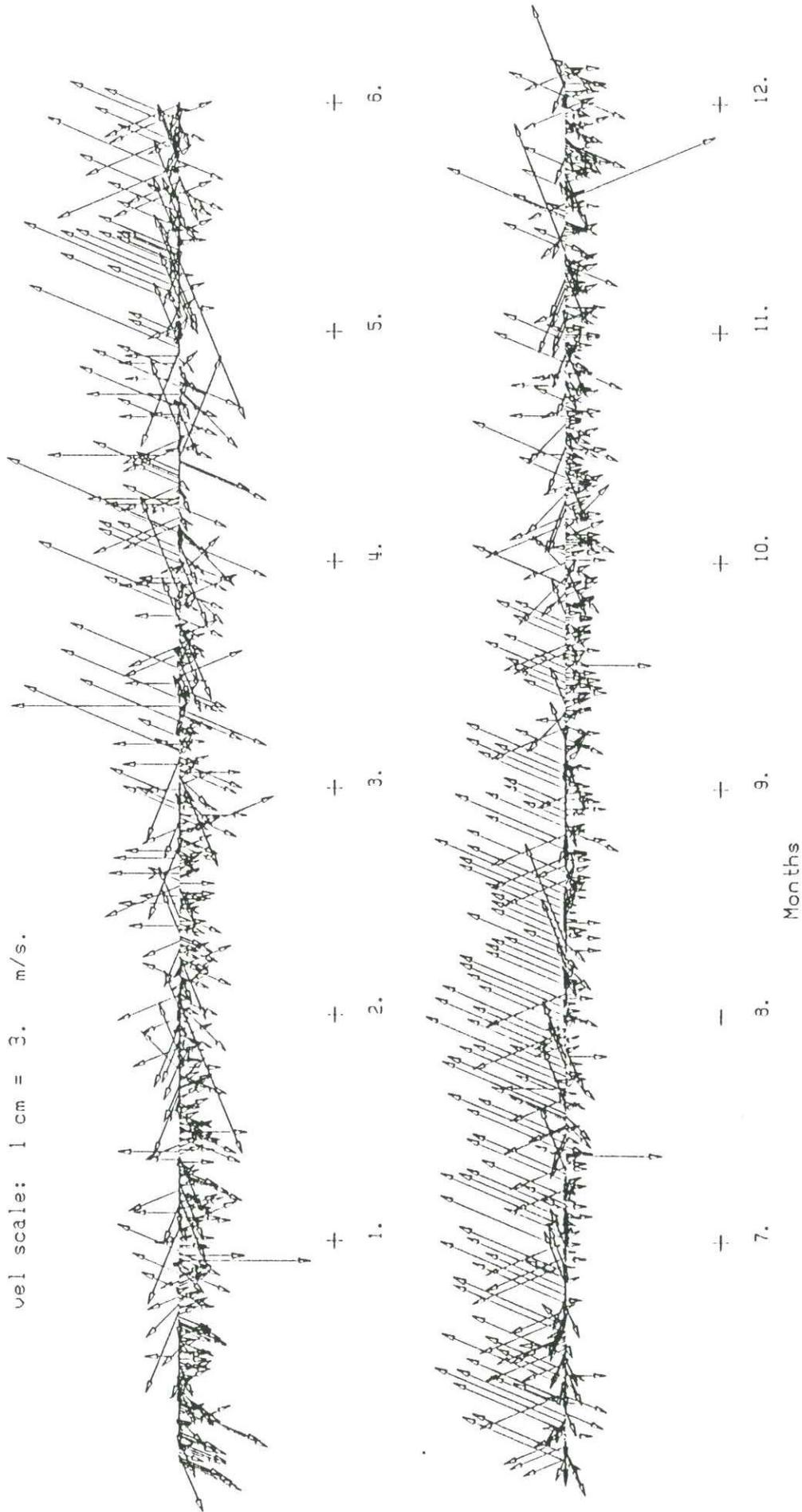
+ 7. 8. 9. 10. 11. 12. +

Months

SEKİL. I. 30 Mersin rüzgar hızı vektörleri 1979

Mersin wind velocity vector 1980

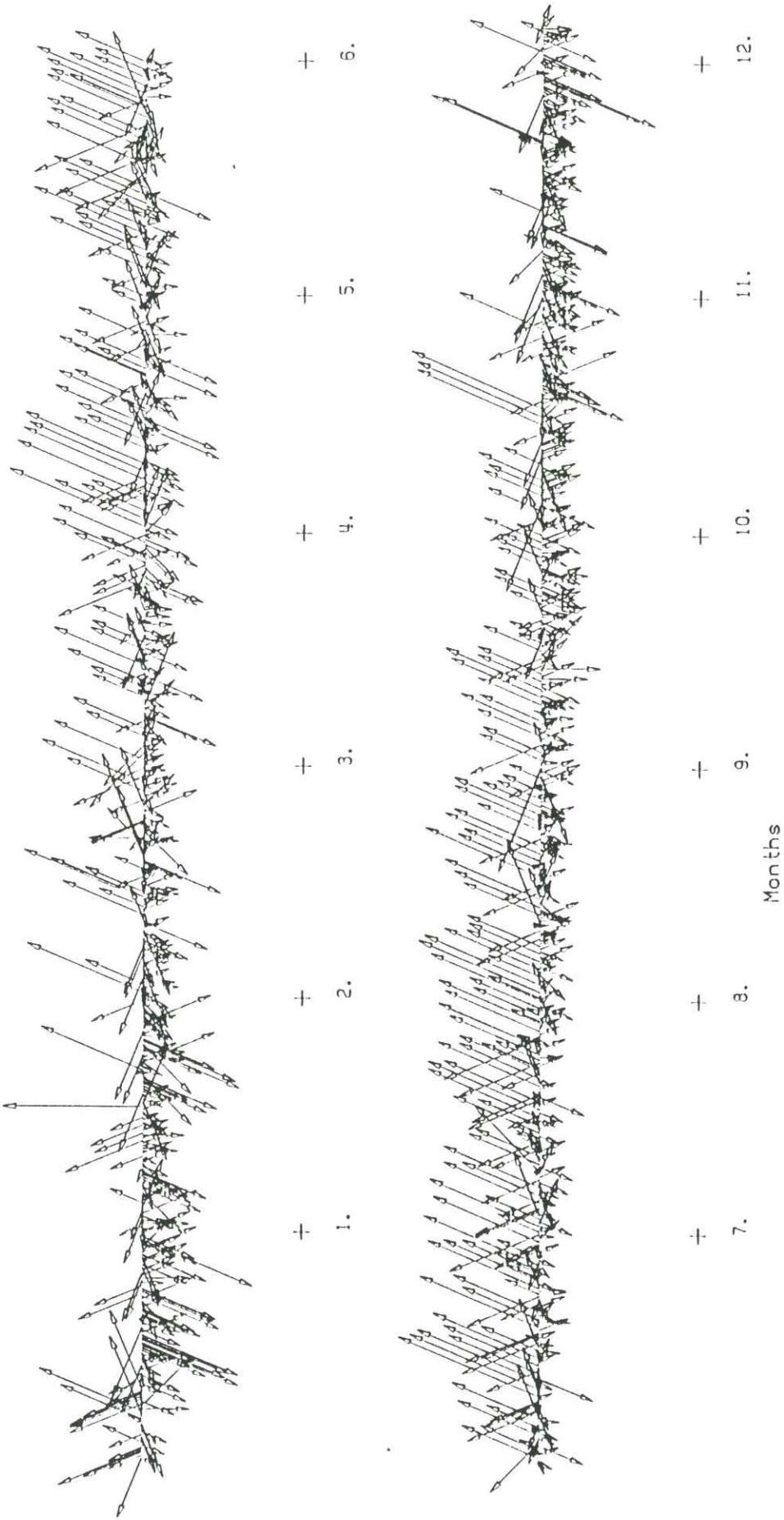
vel scale: 1 cm = 3. m/s.



SEKİL. I.31 Mersin ruzgar hızı vektörleri 1980

Mersin wind velocity vector 1981

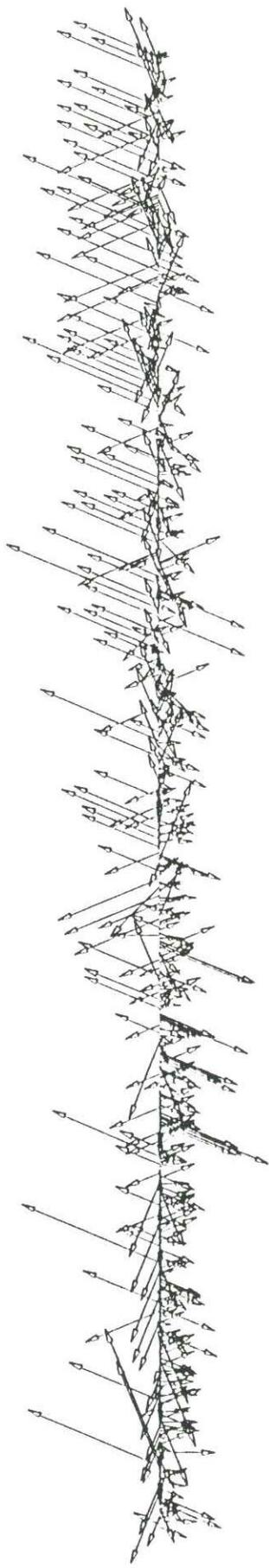
vel scale: 1 cm = 3. m/s.



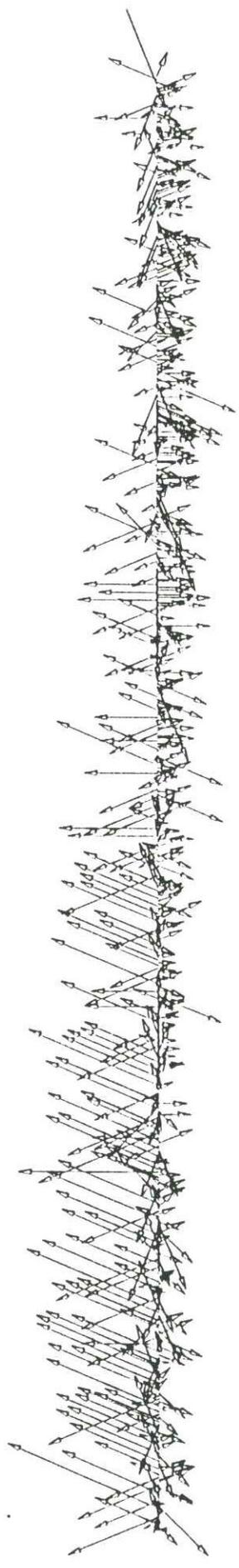
SEKİL. I.32 Mersin rüzgar hızı vektörleri 1981

Mersin wind velocity vector 1982

vel scale: 1 cm = 3. m/s.



+ 1. 2. 3. 4. 5. 6.



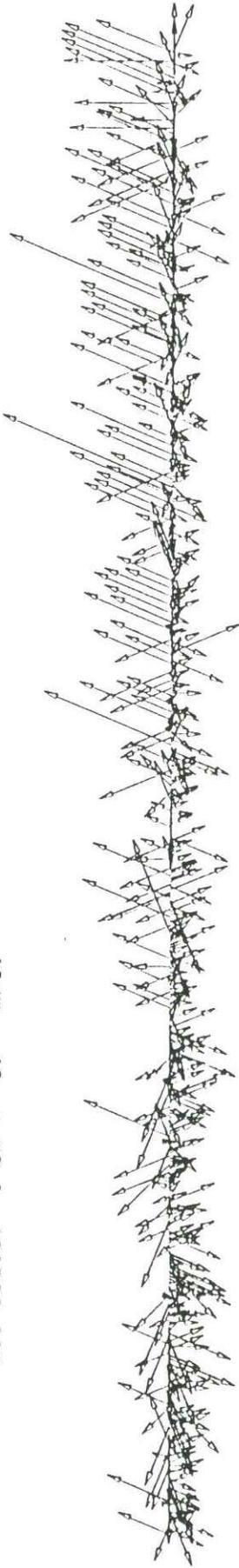
+ 7. 8. 9. 10. 11. 12.

Months

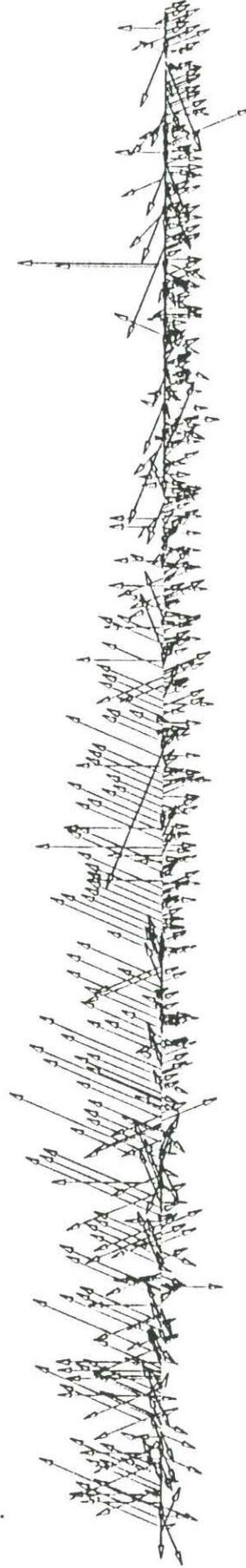
SEKİL. I.33 Mersin ruzgar hızı vektörleri 1982

Mersin wind velocity vector 1983

vel scale: 1 cm = 3. m/s.



+ 1. 2. 3. 4. 5. +

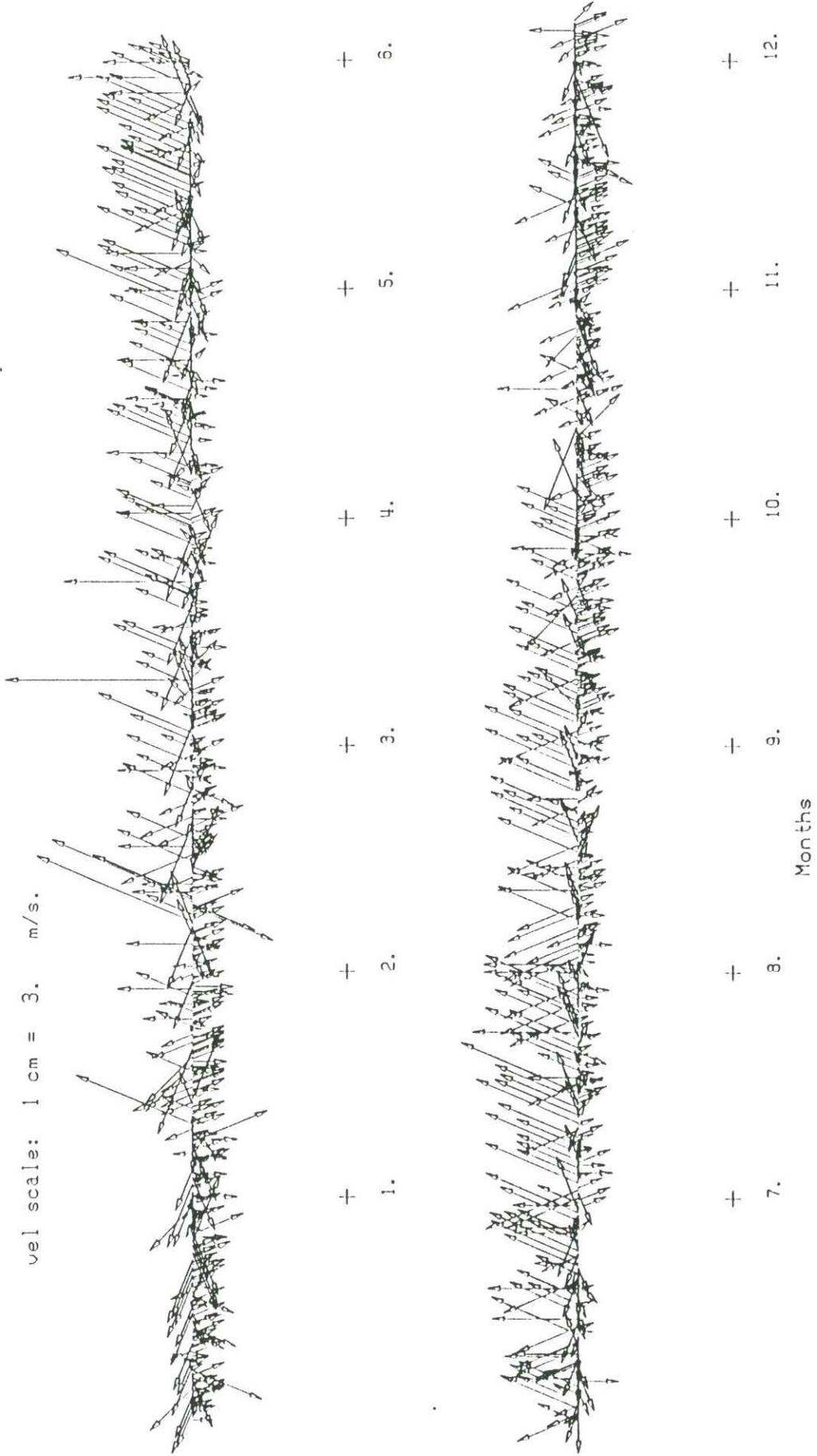


+ 7. 8. 9. 10. 11. 12. +
Months

SEKİL. I. 34 Mersin rüzgar hızı vektörleri 1983

Mersin wind velocity vector 1984

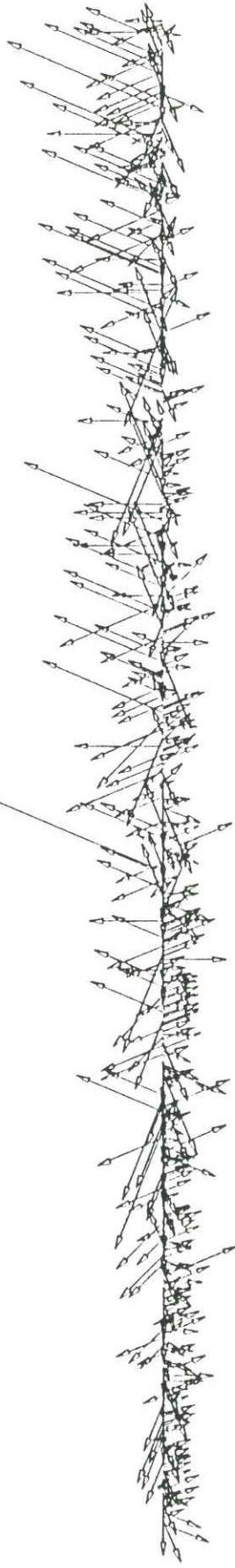
vel scale: 1 cm = 3. m/s.



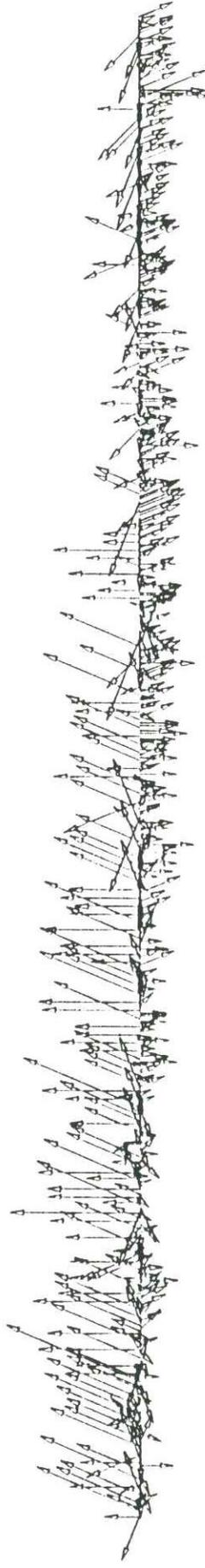
SEKİL. I.35 Mersin ruzgar hızı vektorleri 1984

Mersin wind velocity vector 1985

vel scale: 1 cm = 3. m/s.



+ 1. 2. 3. 4. 5. 6.



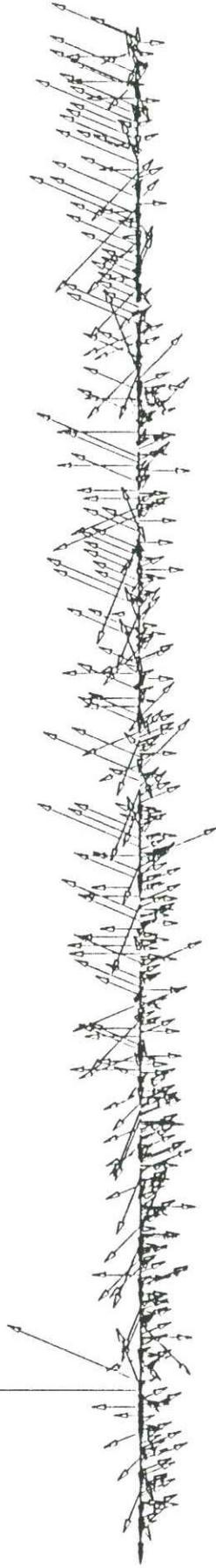
+ 7. 8. 9. 10. 11. 12.

Months

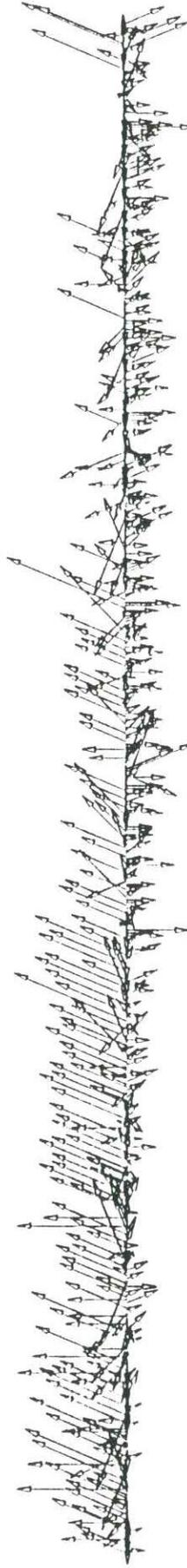
SEKIL. I.36 Mersin ruzgar hızı vektörleri 1985

Mersin wind velocity vector 1986

vel scale: 1 cm = 3. m/s.



+ 1. 2. 3. 4. 5. 6.



+ 7. 8. 9. 10. 11. 12.

Months

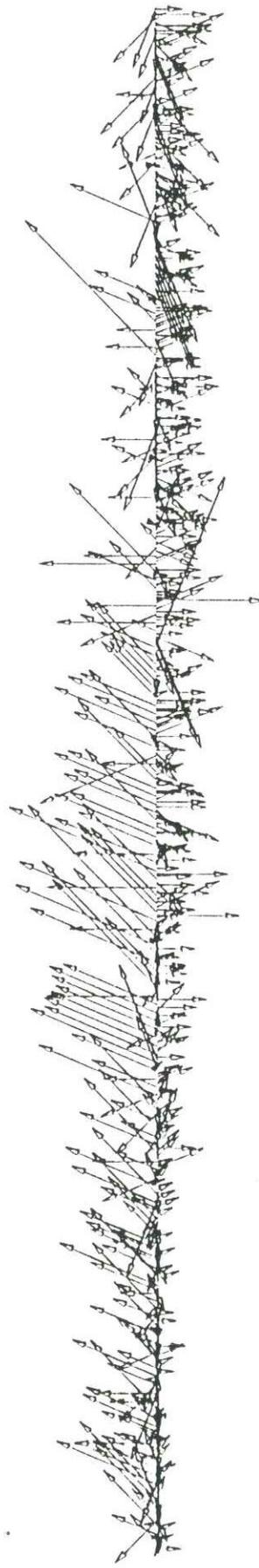
SEKİL. I.37 Mersin rüzgar hızı vektörleri 1986

Mersin wind velocity vector 1987

vel scale: 1 cm = 3. m/s.



- + 1.
- + 2.
- + 3.
- + 4.
- + 5.
- + 6.

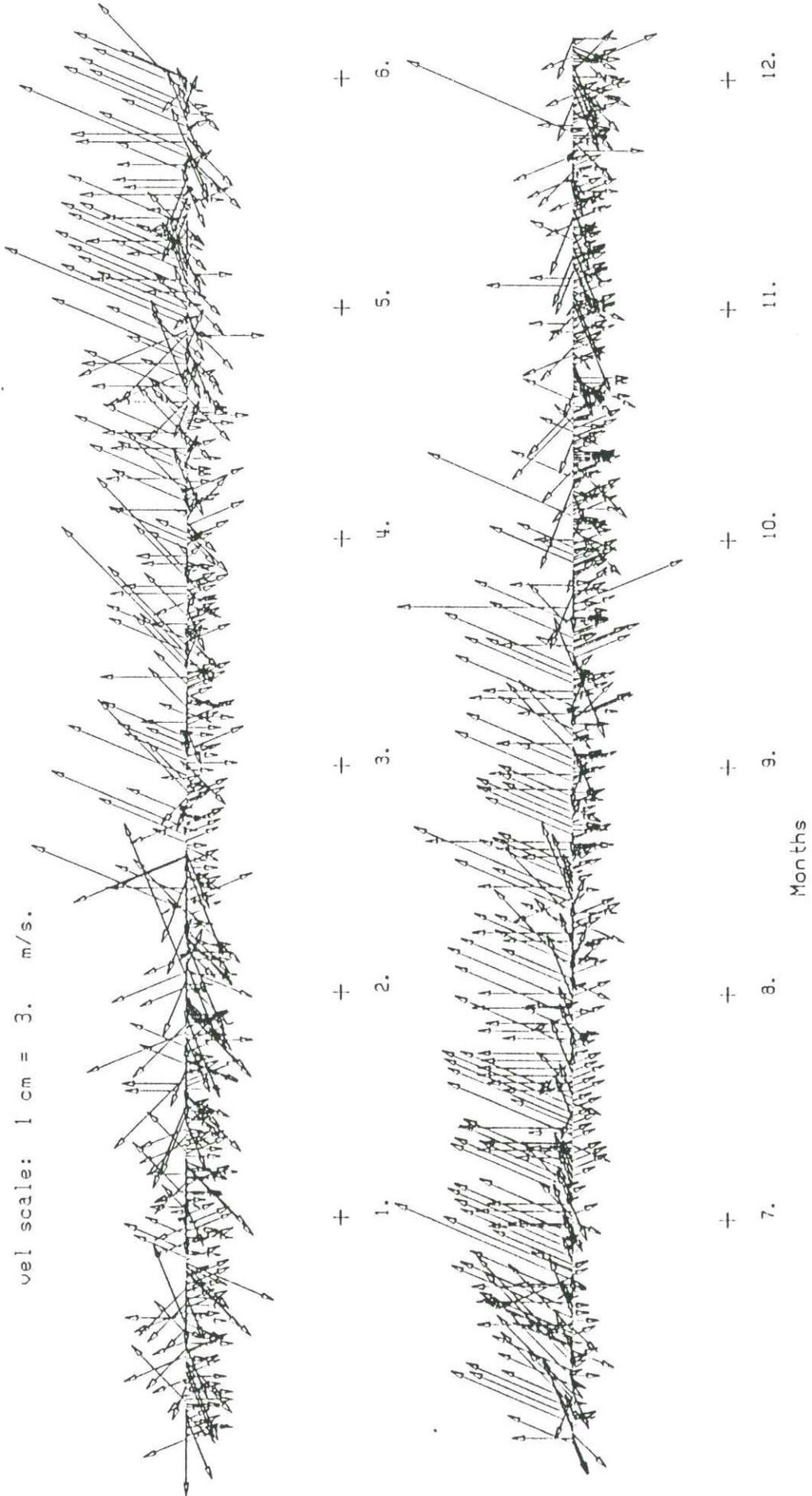


- + 7.
 - + 8.
 - + 9.
 - + 10.
 - + 11.
 - + 12.
- Months

SEKIL. I.38 Mersin ruzgar hızı vektorleri 1987

Mersin wind velocity vector 1988

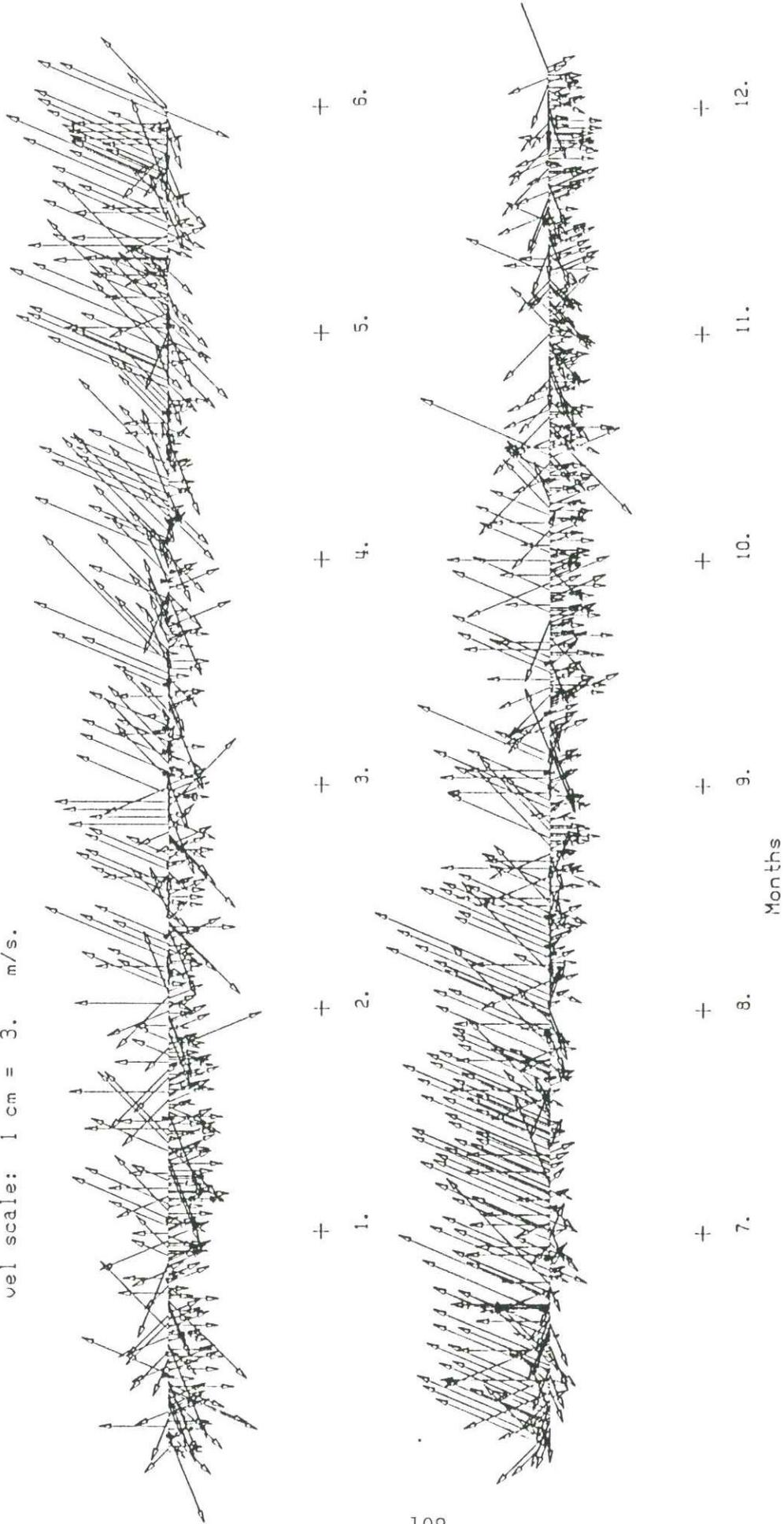
vel scale: 1 cm = 3. m/s.



SEKİL. I. 39 Mersin rüzgar hızı vektörleri 1988

Mersin wind velocity vector 1989

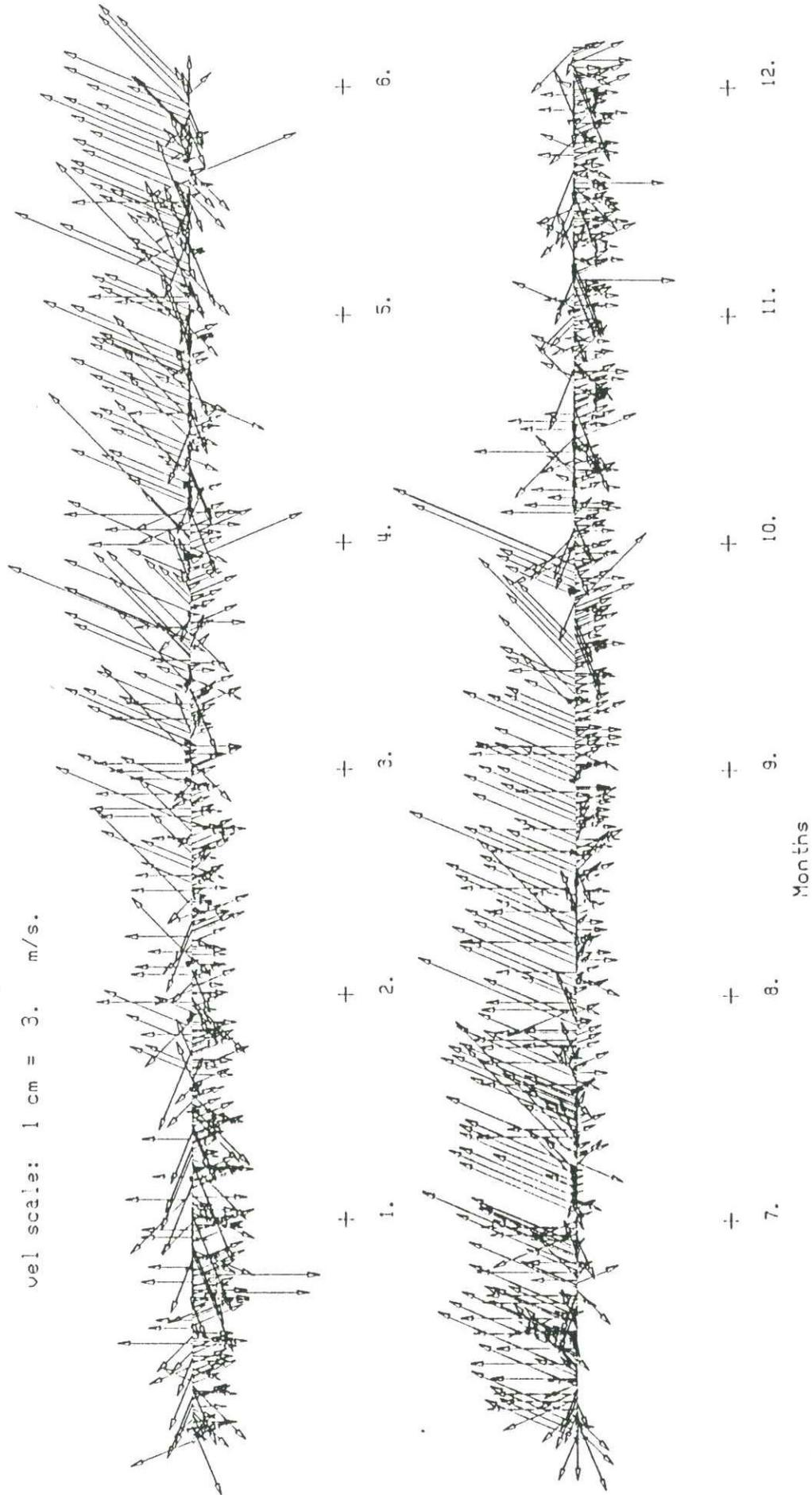
vel scale: 1 cm = 3. m/s.



SEKİL. I. 40 Mersin rüzgar hızı vektorleri 1989

Mersin wind velocity vector 1990

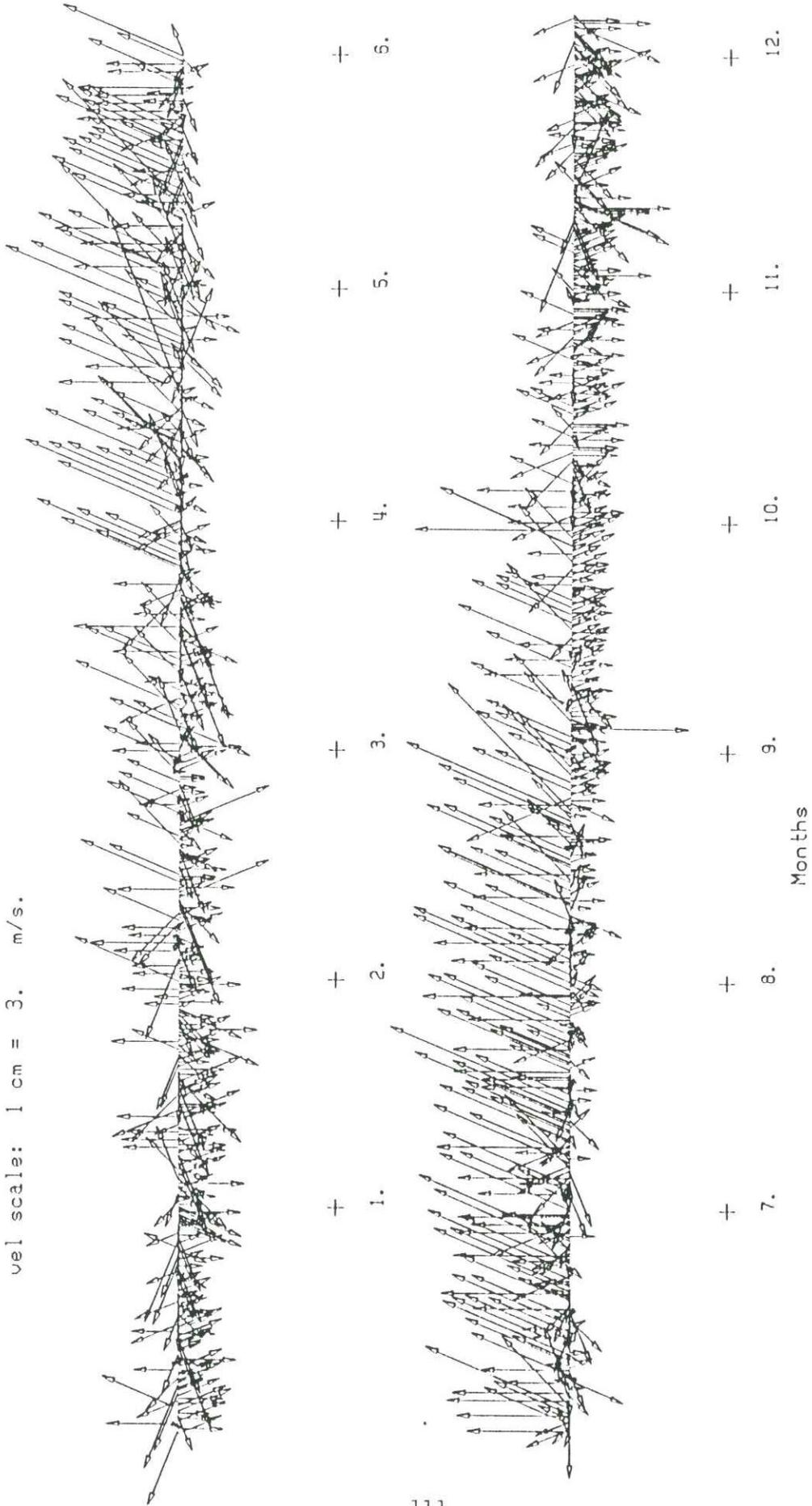
vel scale: 1 cm = 3. m/s.



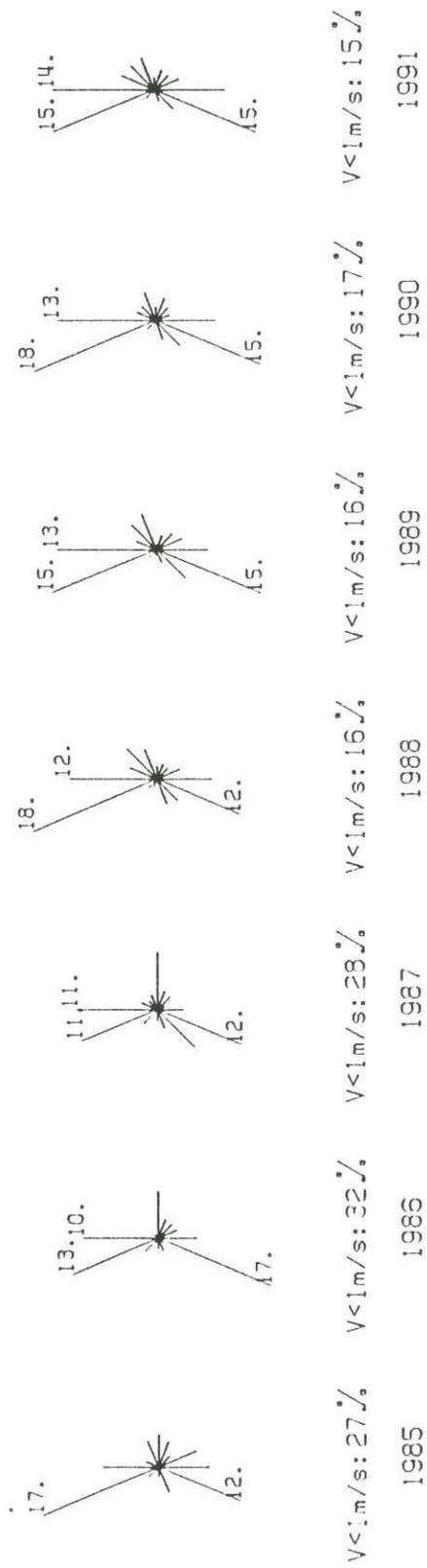
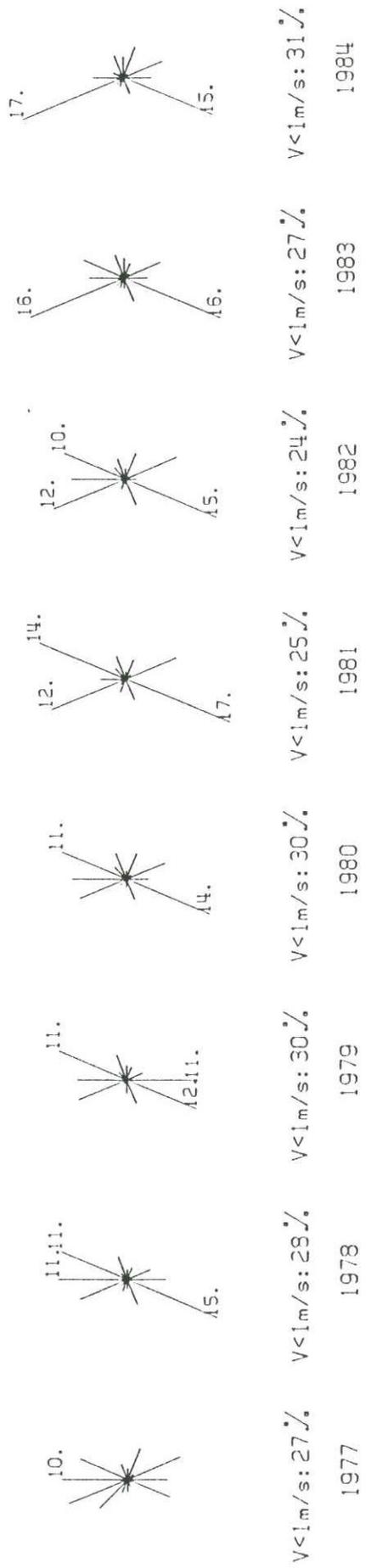
SEKİL. I.41 Mersin rüzgar hızı vektörleri 1990

Mersin wind velocity vector 1991

vel scale: 1 cm = 3. m/s.

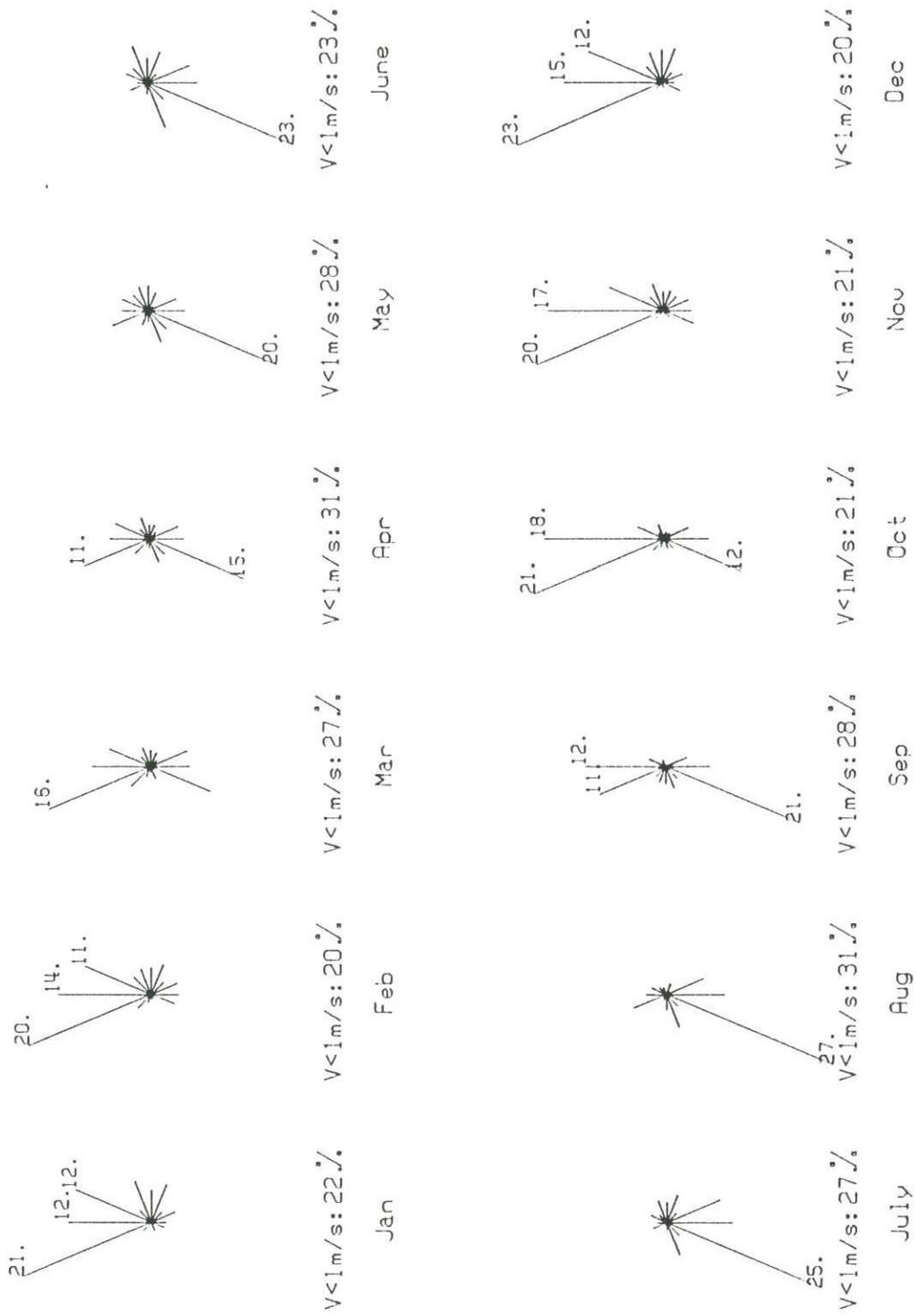


SEKİL. I. 42 Mersin rüzgar hızı vektorleri 1991



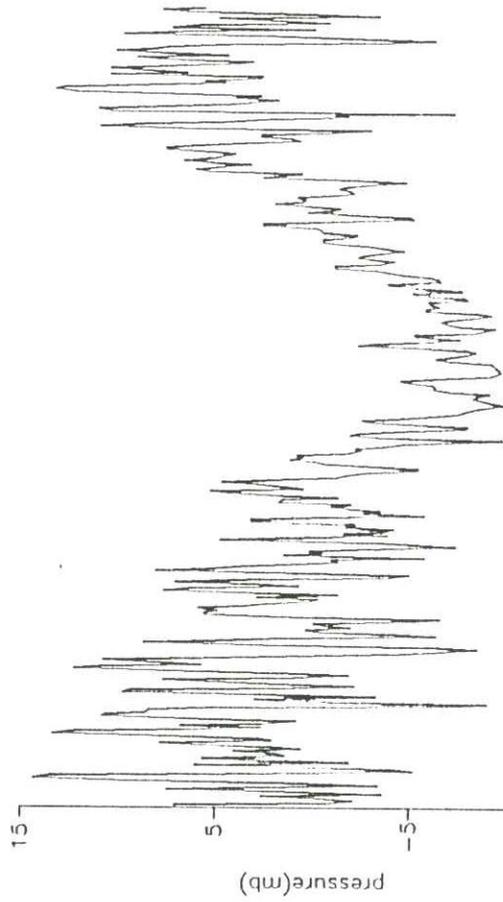
Annual wind frequency 1977-1991

SEKİL I. 43 Rüzgar frekansları

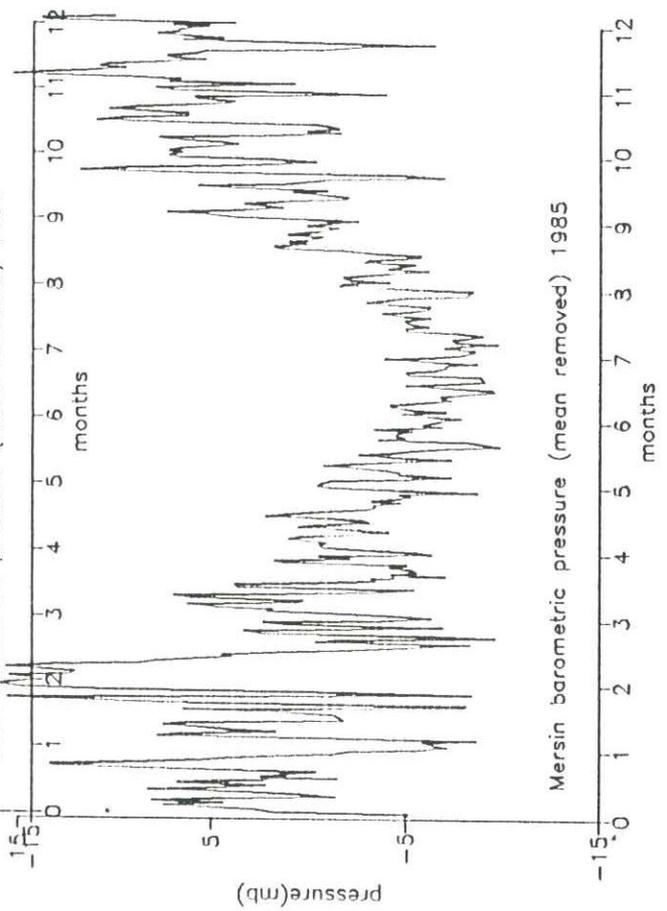


Monthly average wind frequency 1977-1991

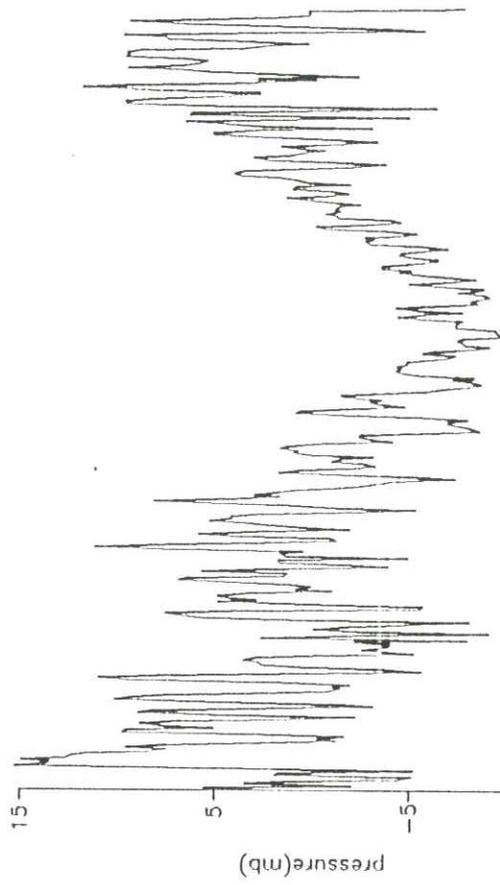
SEKIL. I.44 Ruzgar frekanslari



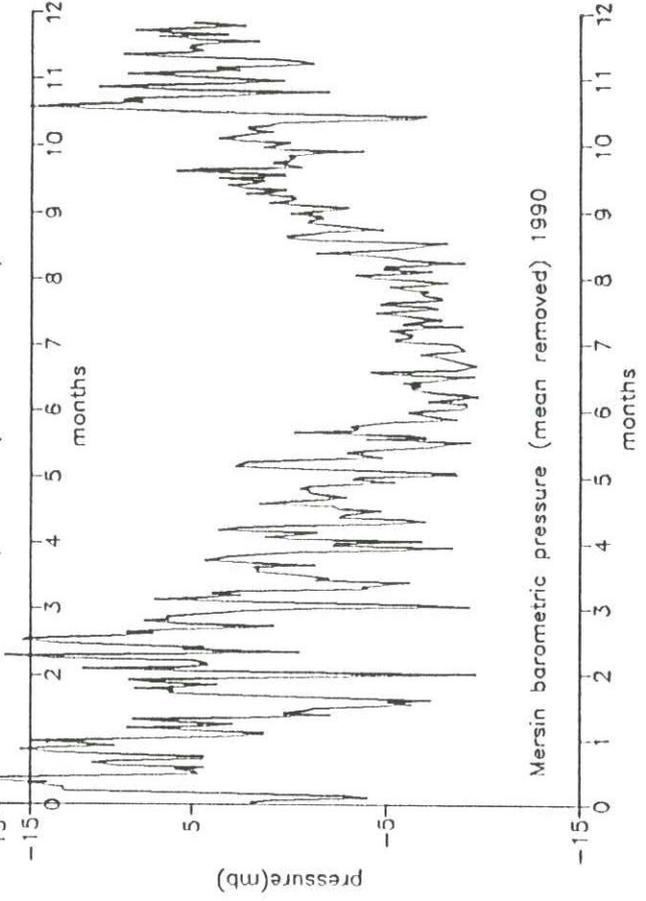
Mersin barometric pressure (mean removed) 1981



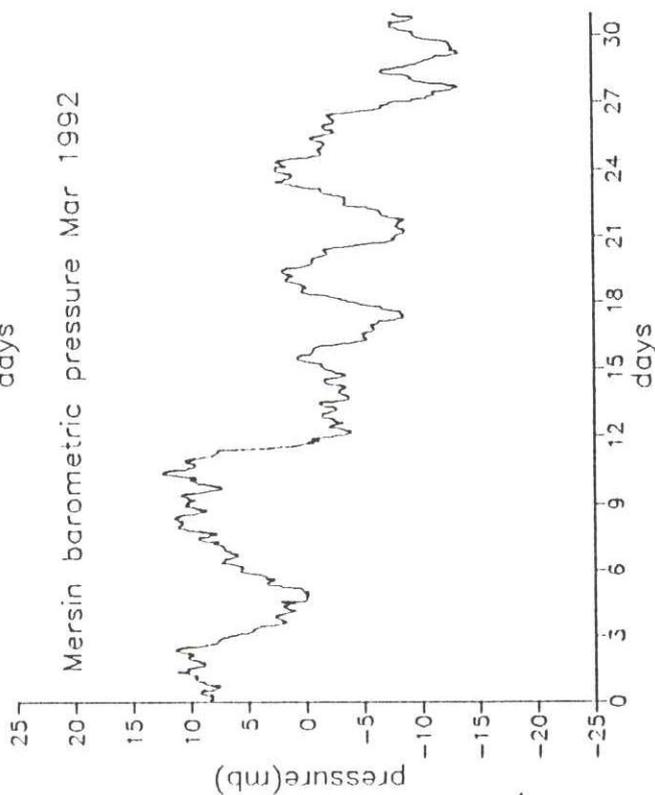
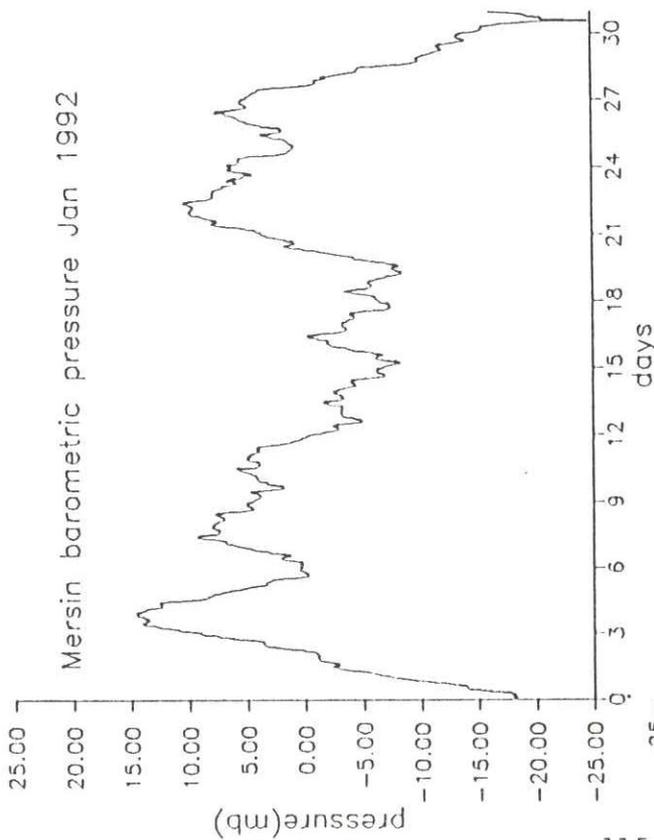
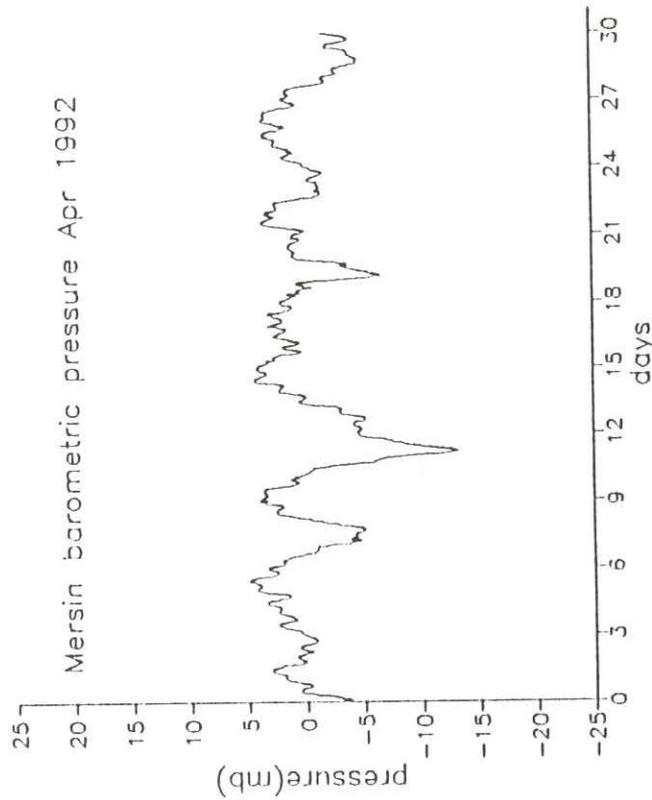
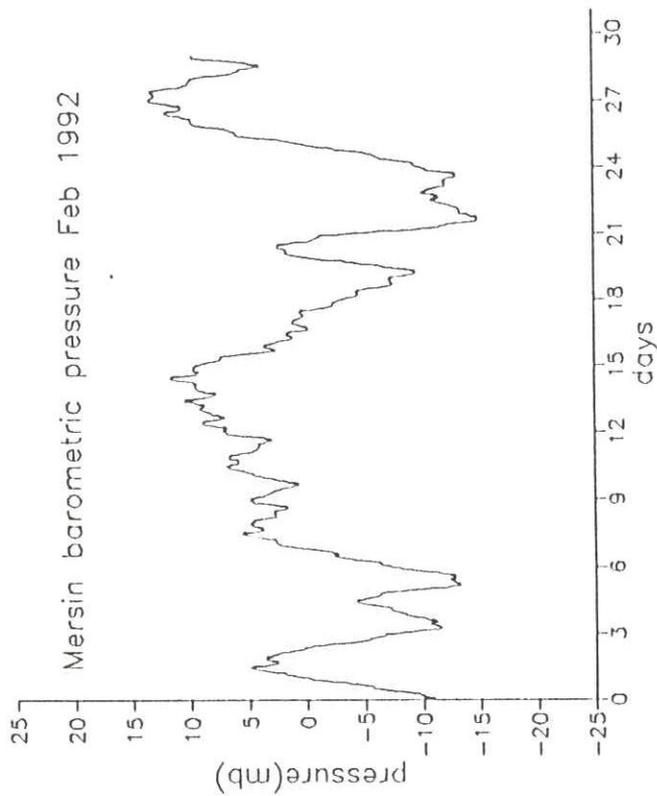
Mersin barometric pressure (mean removed) 1985

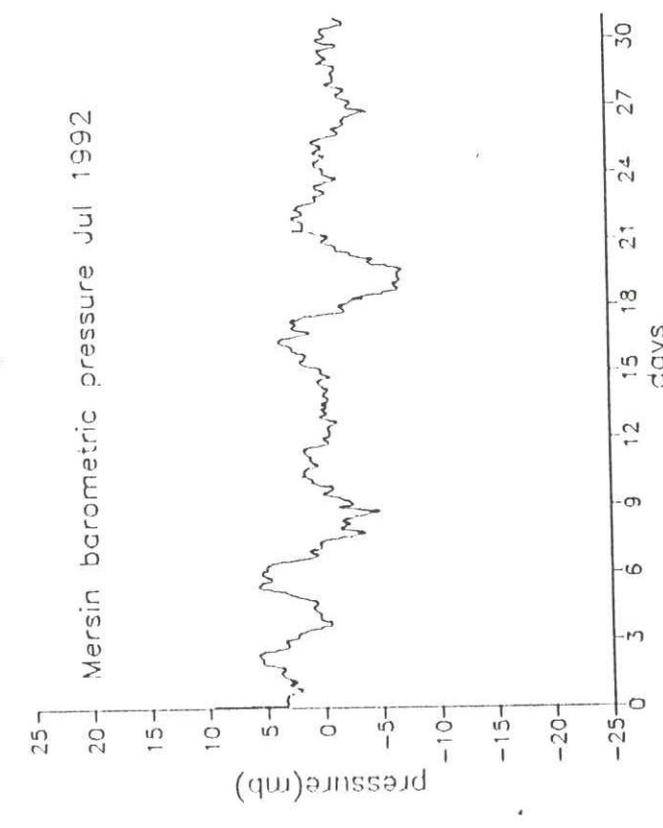
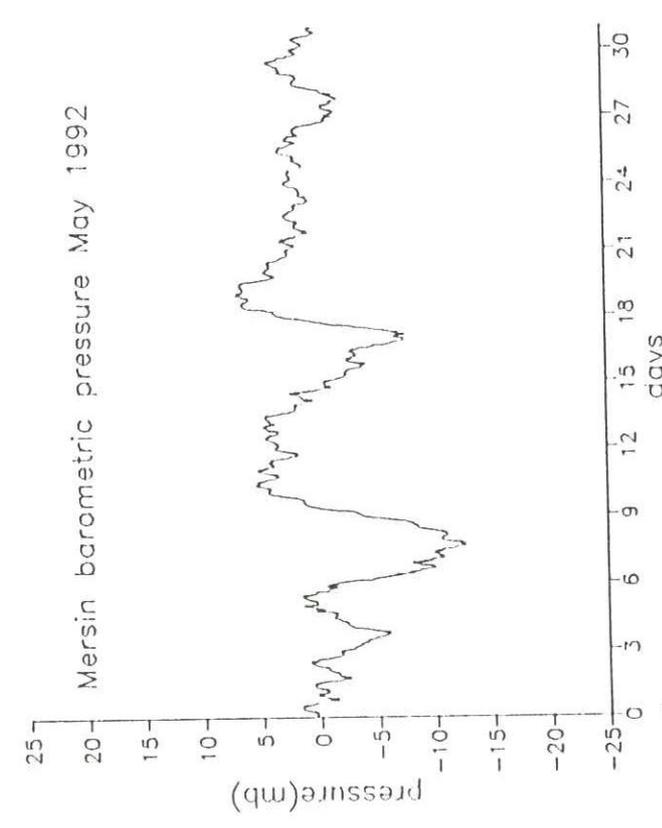
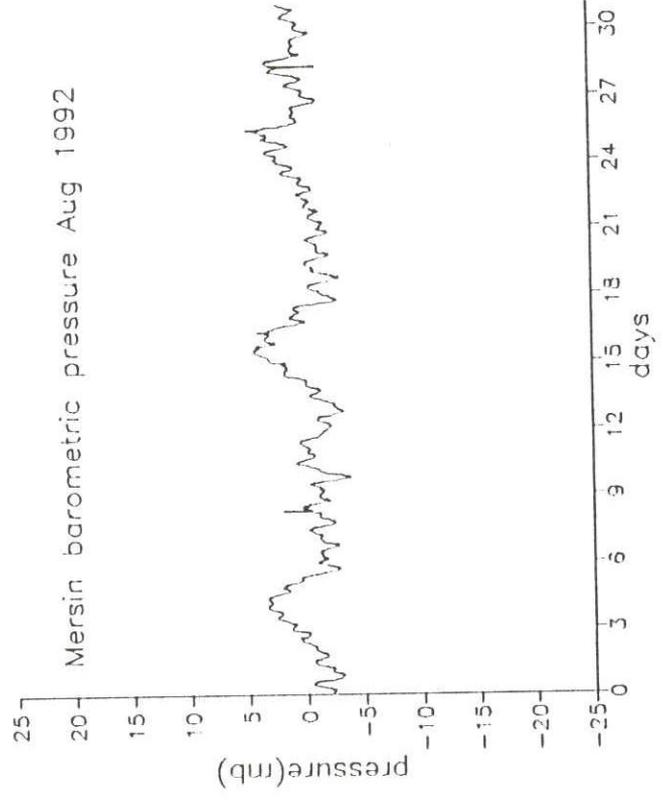
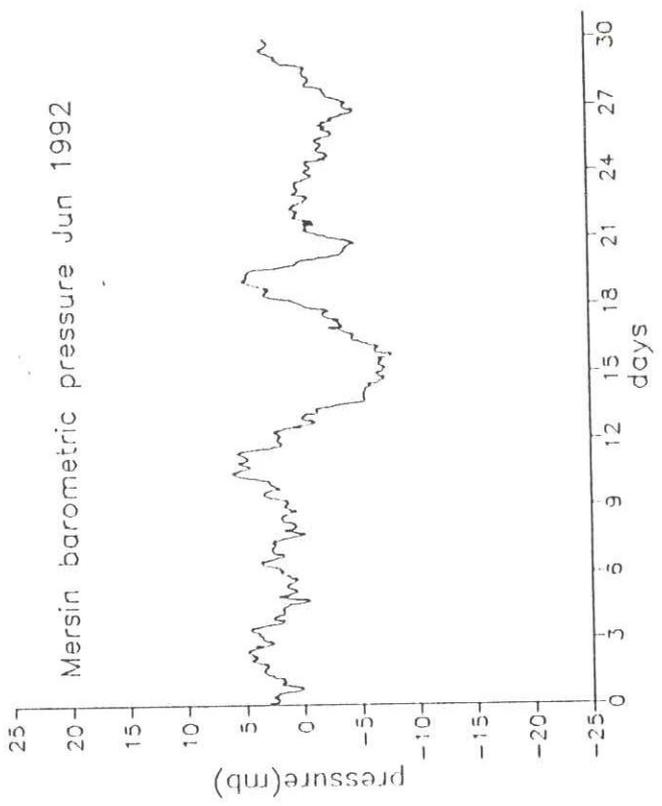


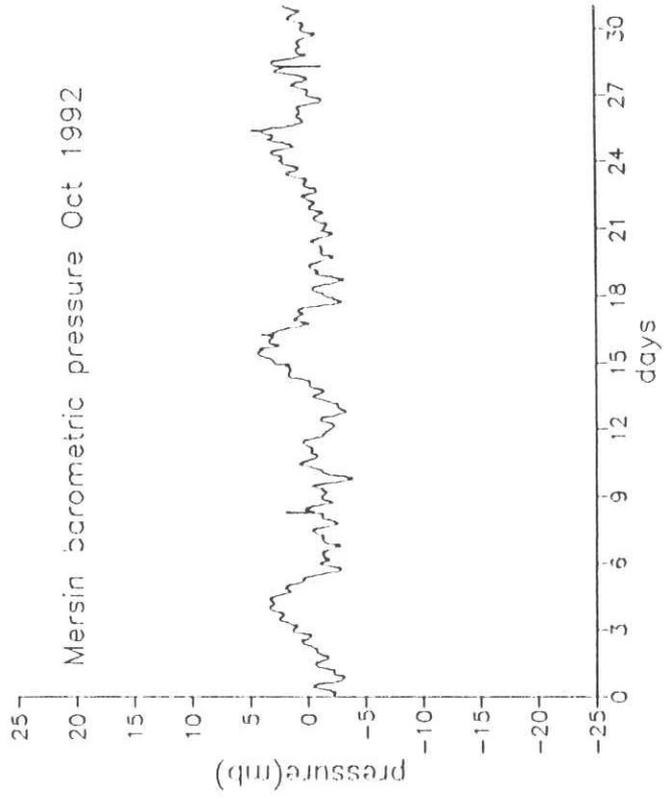
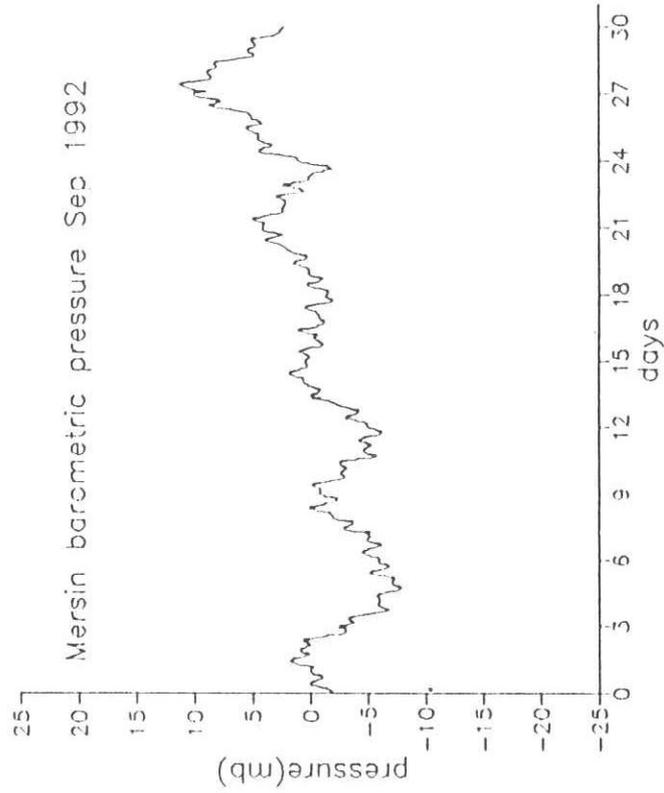
Mersin barometric pressure (mean removed) 1987



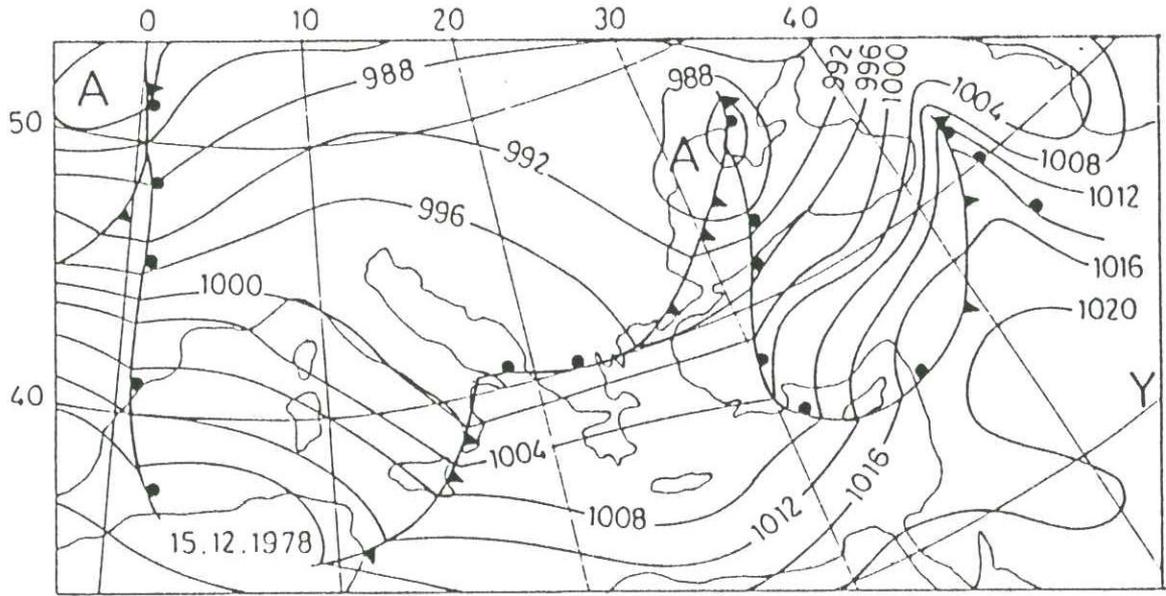
Mersin barometric pressure (mean removed) 1990



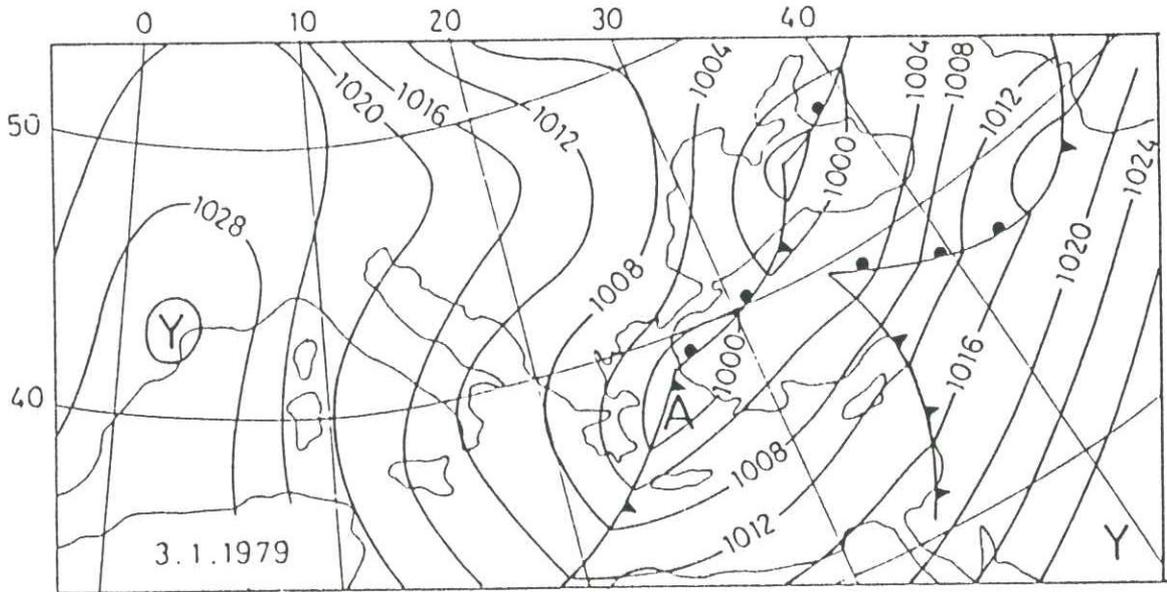




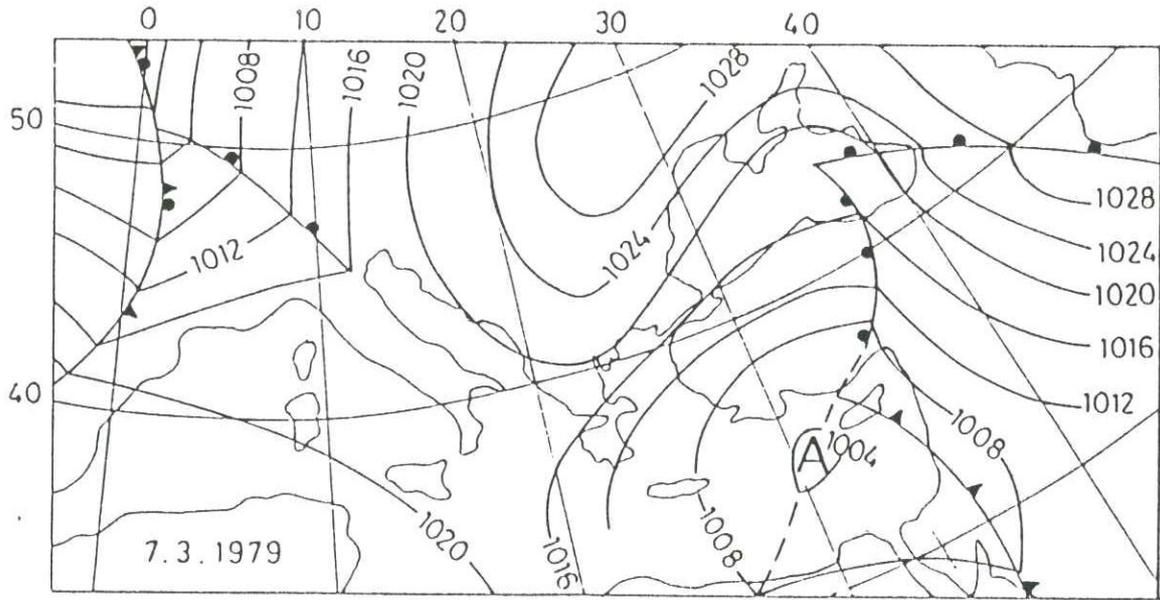
SEKIL.I.46 Barometric basinc



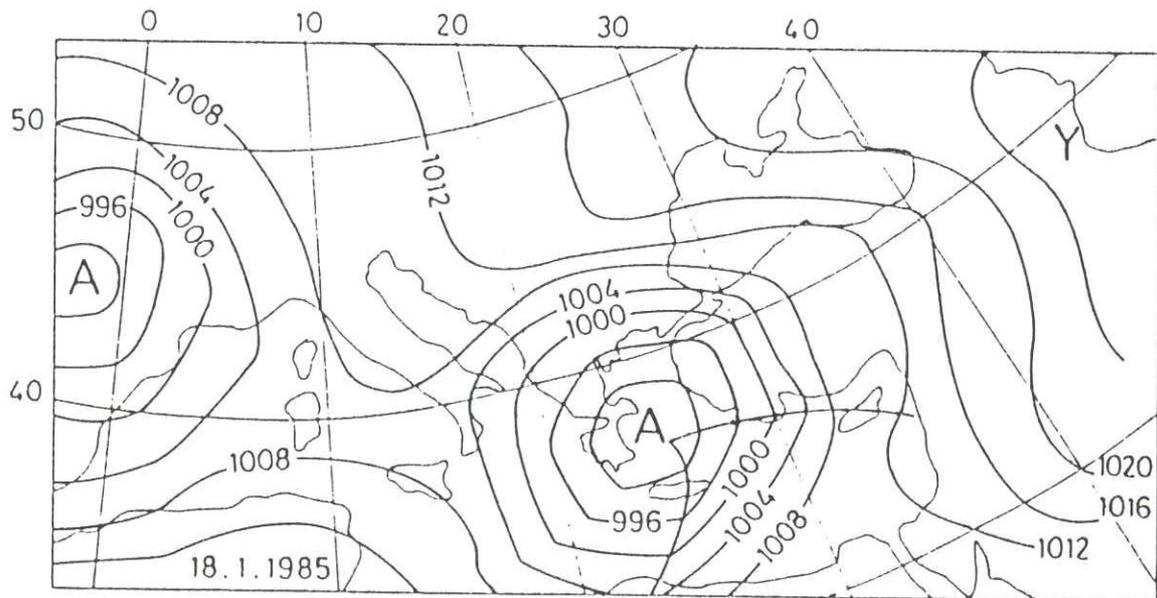
SEKİL. I. 47 (a) 15 Aralık 1978 Yüzey sinoptik haritası



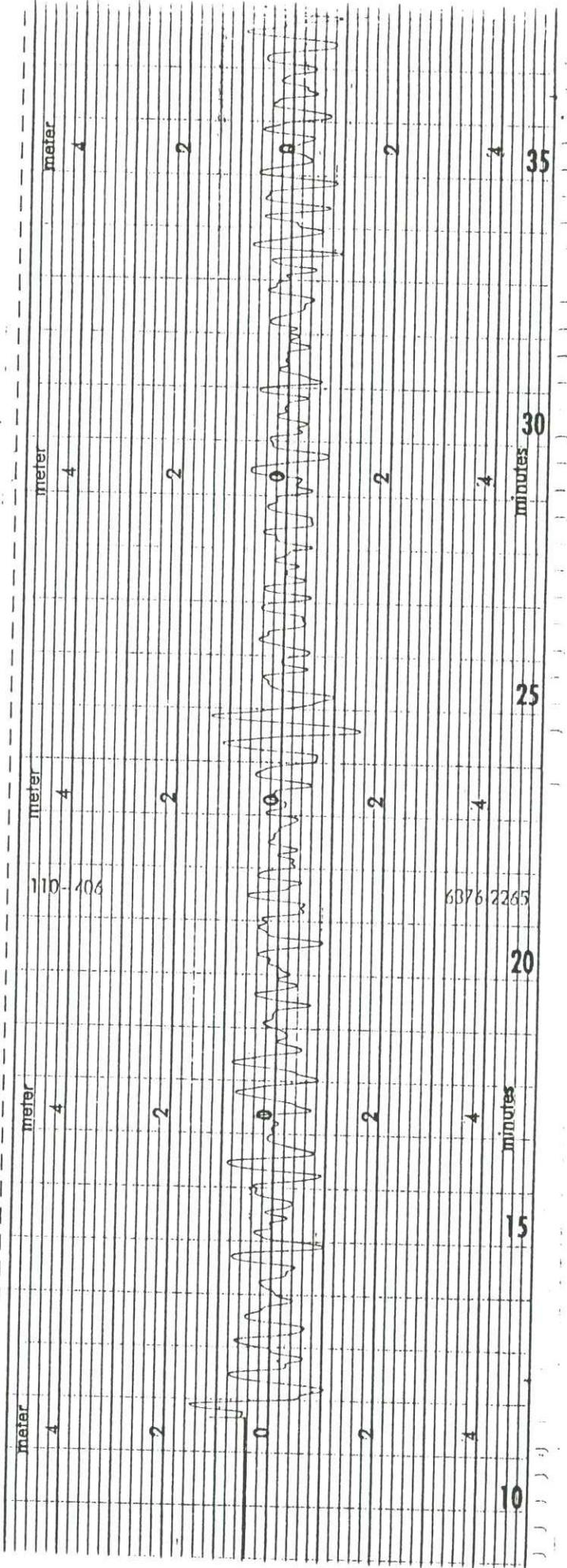
SEKİL. I. 47 (b) 3 Ocak 1979 Yüzey sinoptik haritası



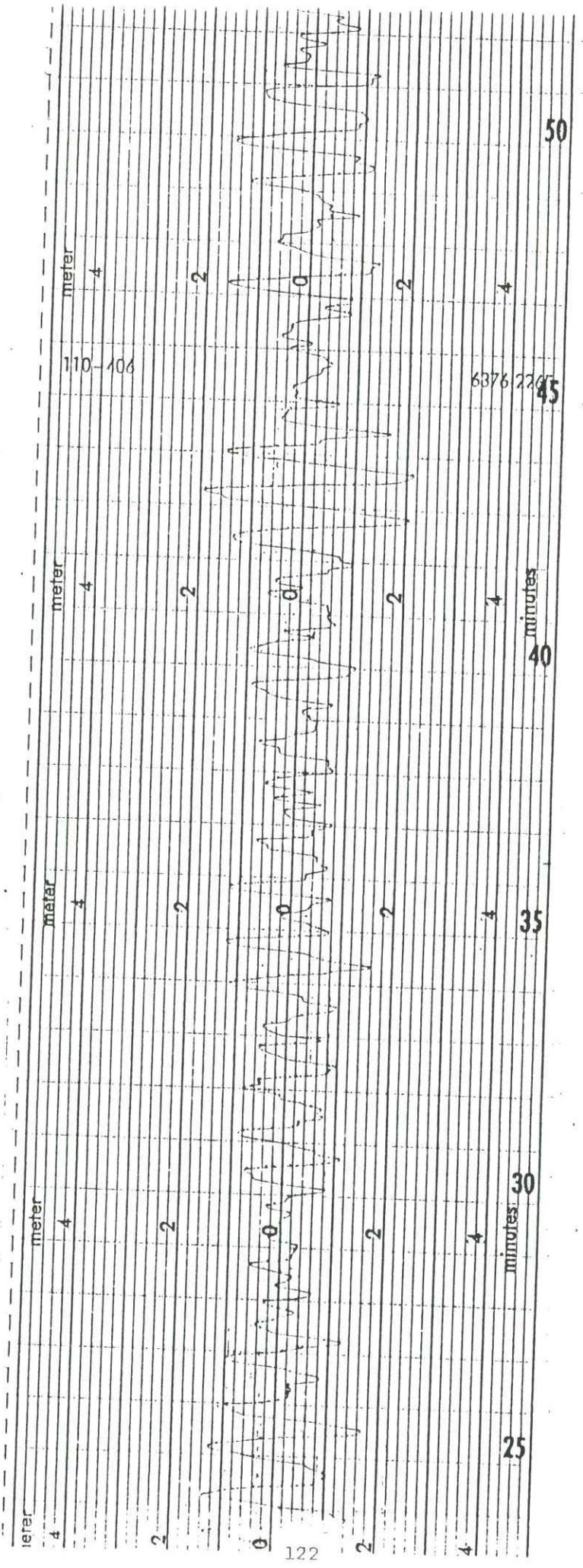
SEKİL.I.47 (c) 7 mart 1979 Yüzey sinoptik haritası



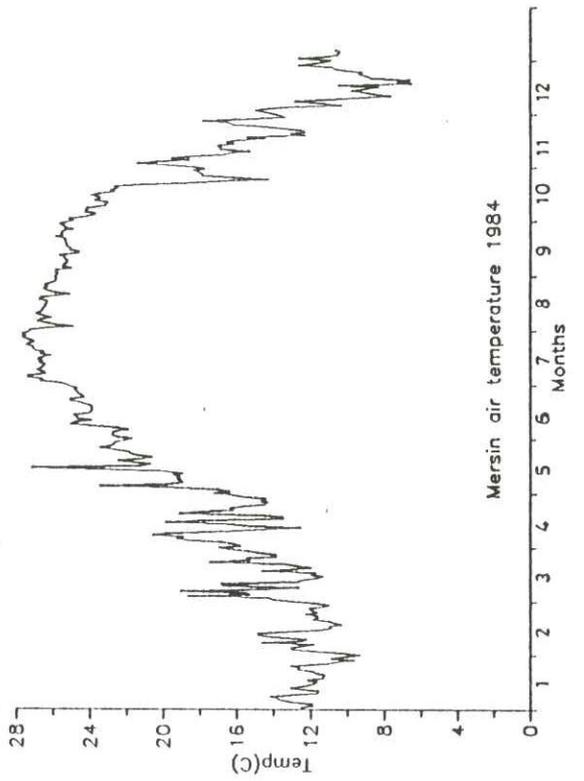
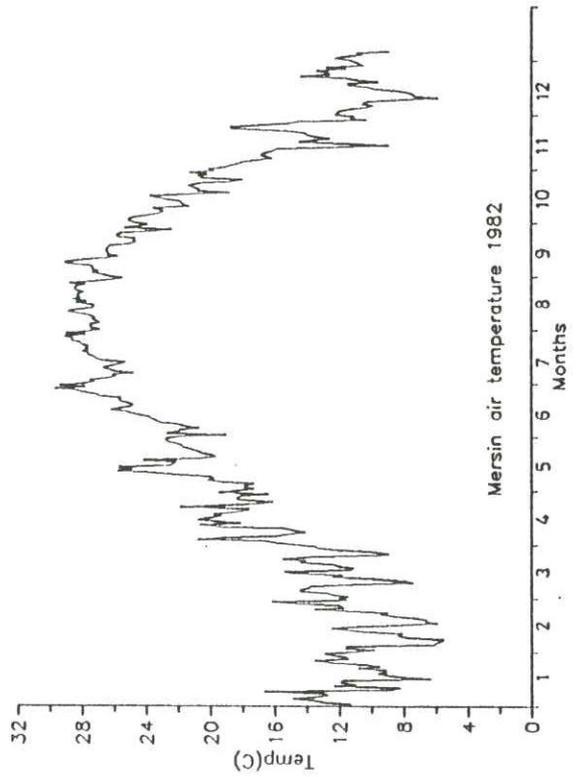
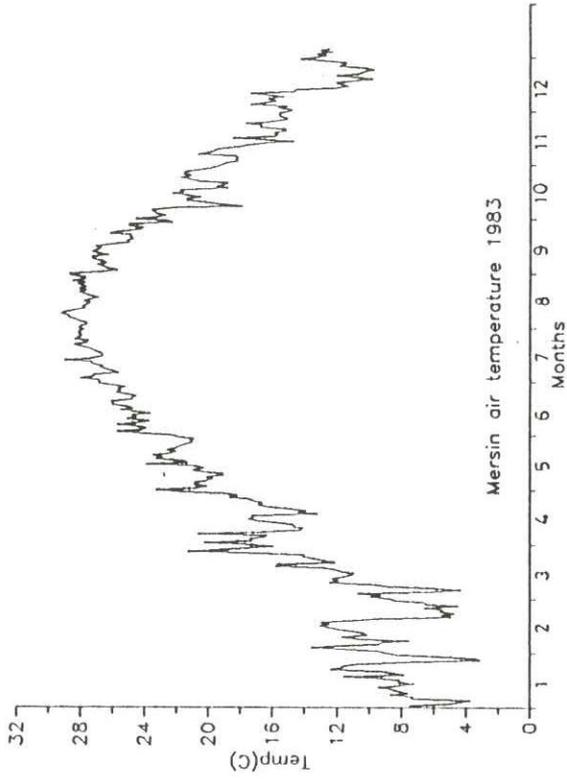
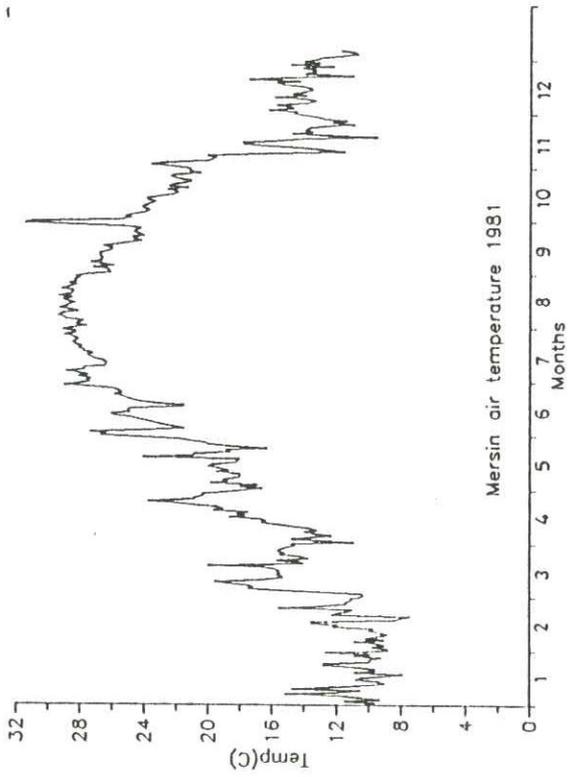
SEKİL.I.47 (d) 18 Ocak 1985 Yüzey sinoptik haritası

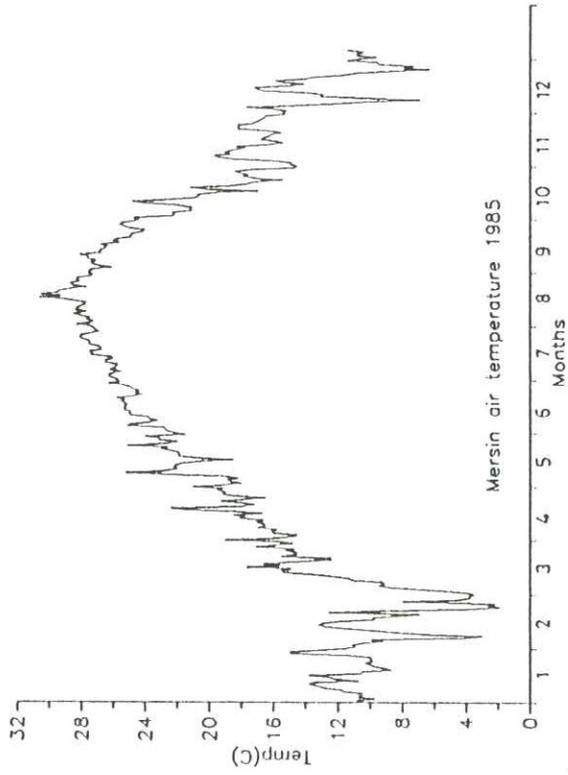


SEKİL. I48 (b) 3 Ocak 1979 Dalga kayıtları

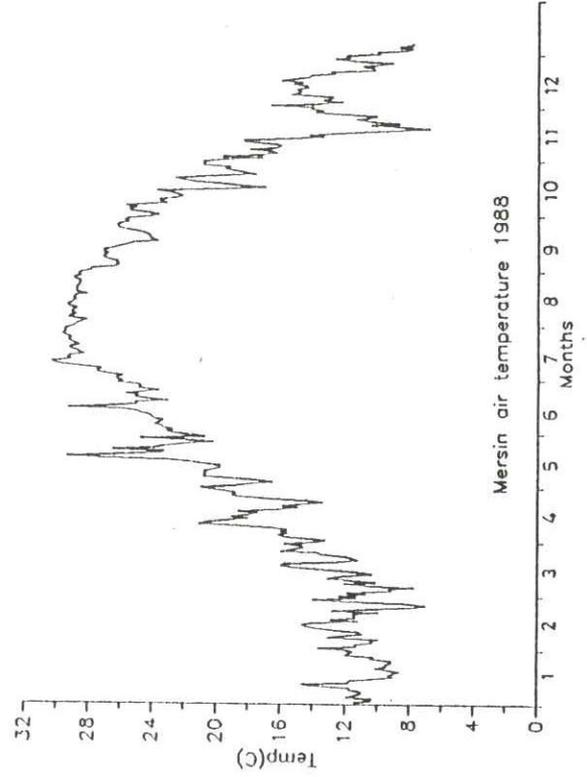
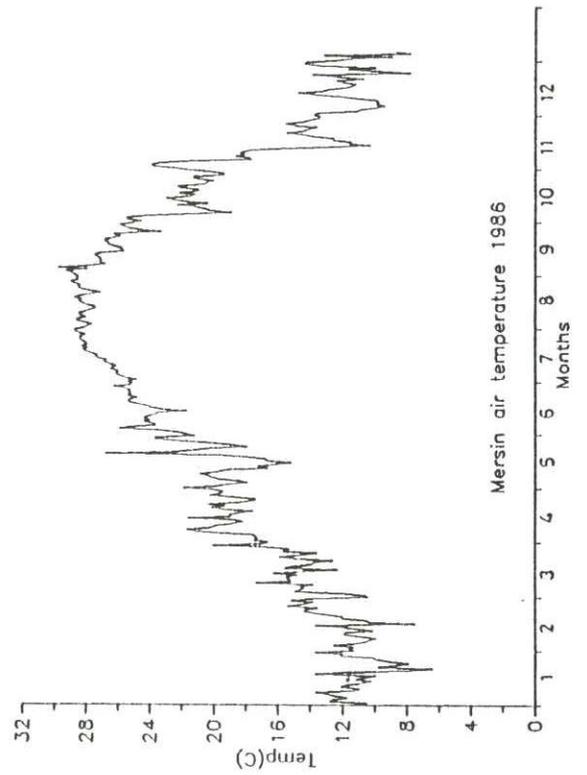
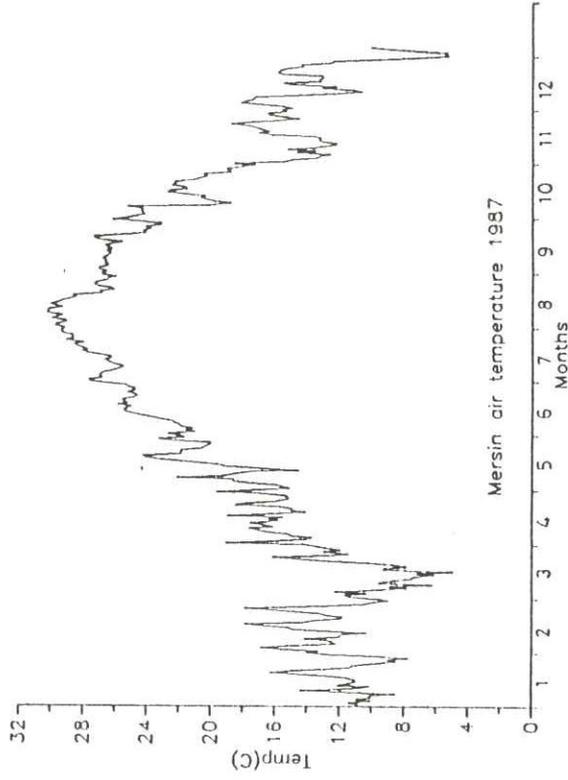


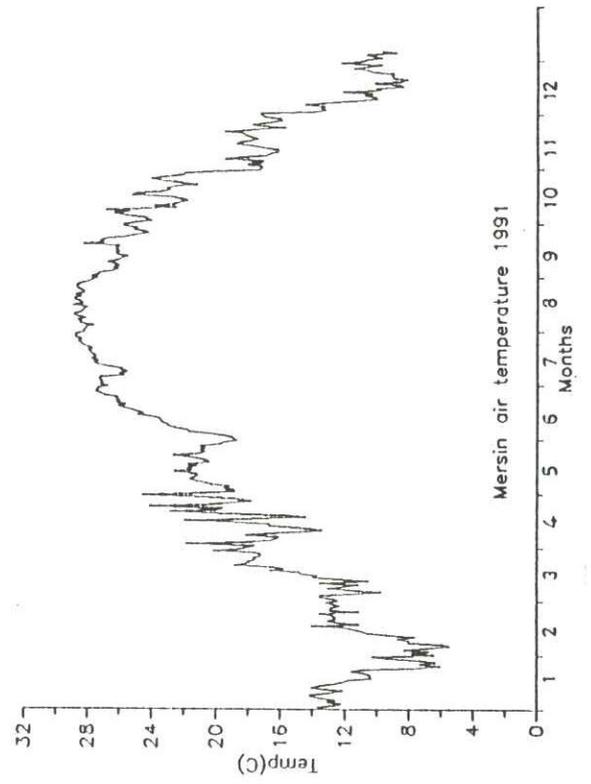
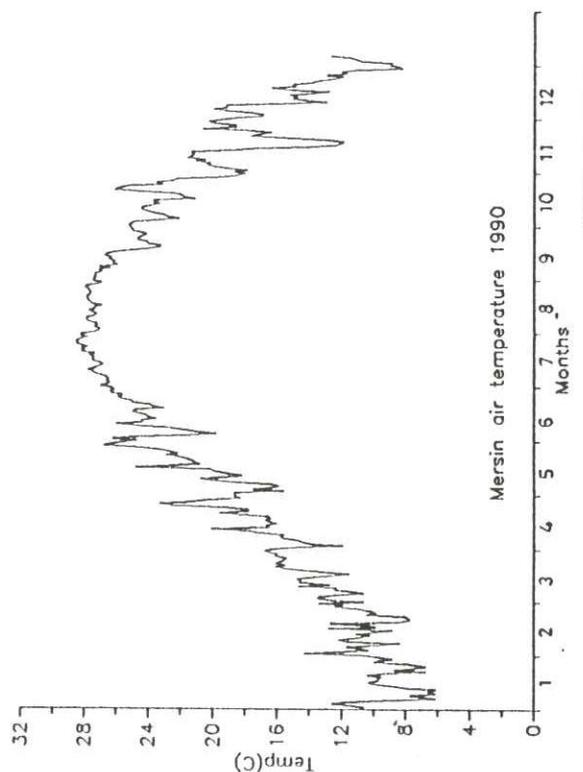
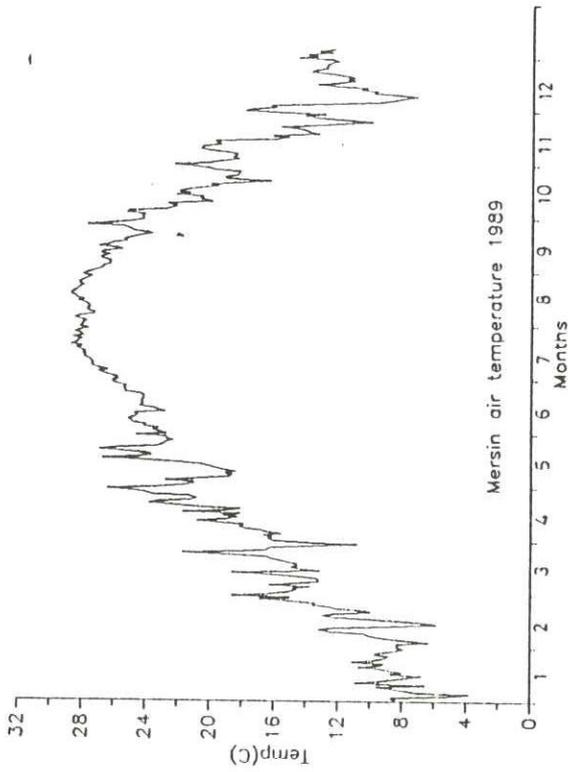
SEKİL. I. 48 (c) 7 Mart 1979 Dalga kayıtları

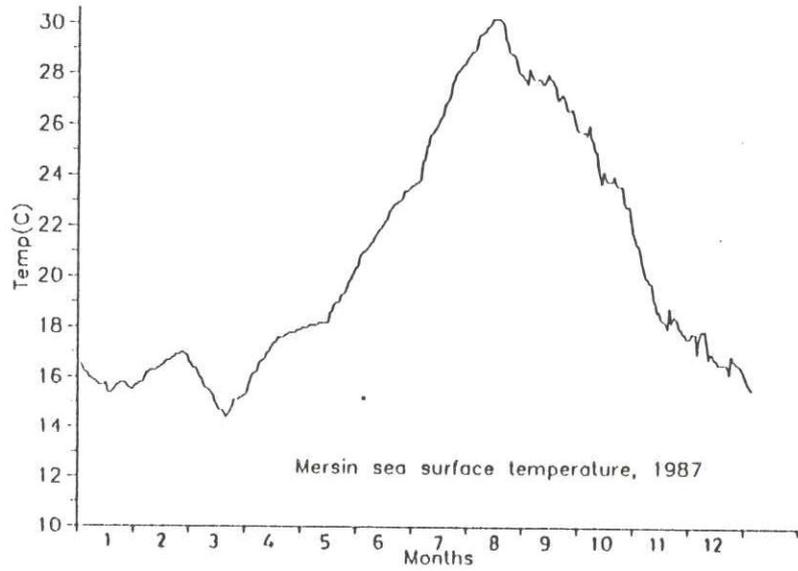
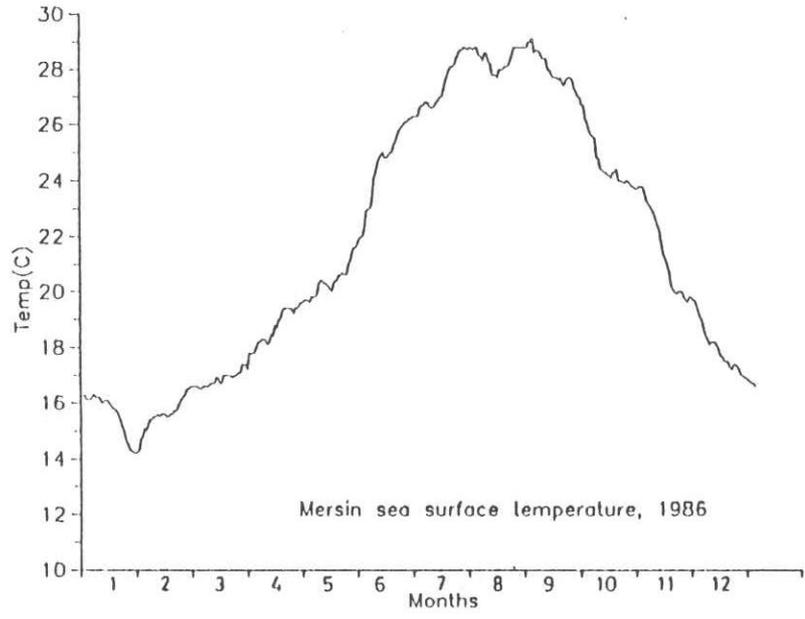
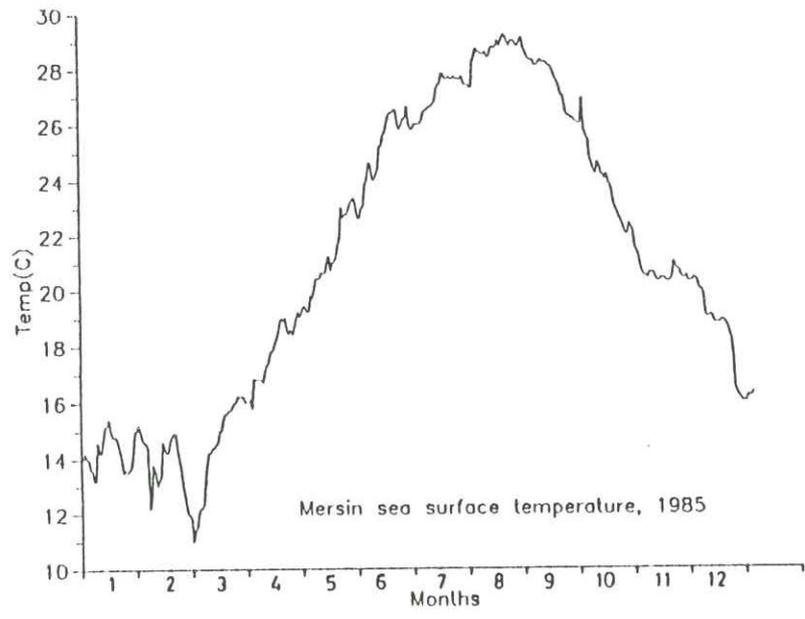




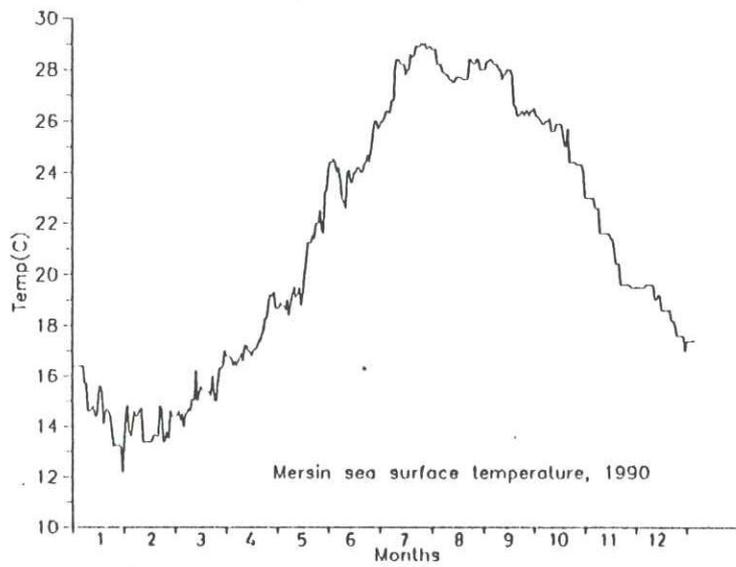
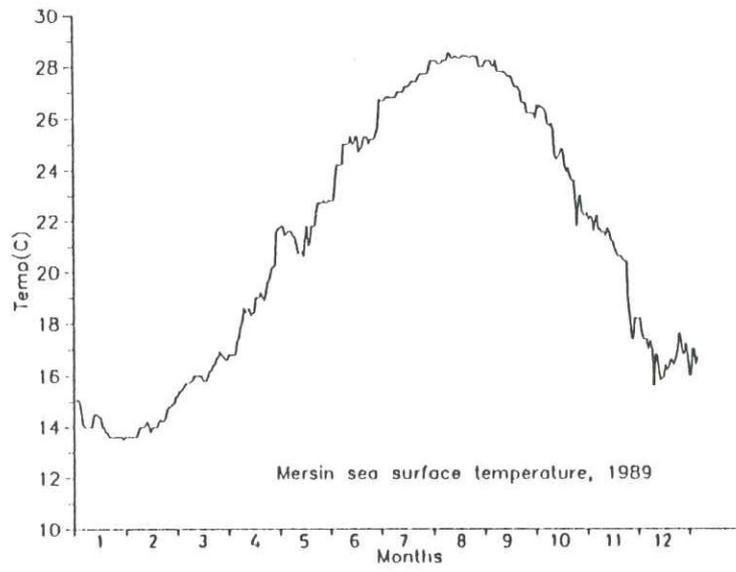
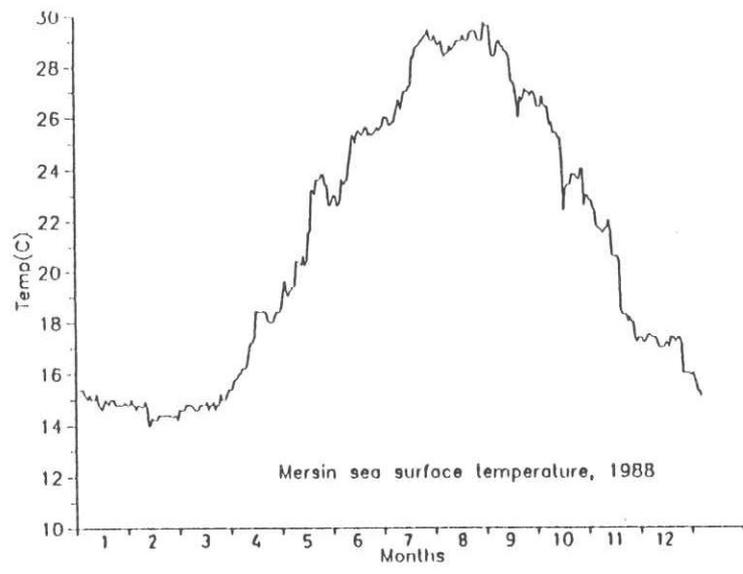
124



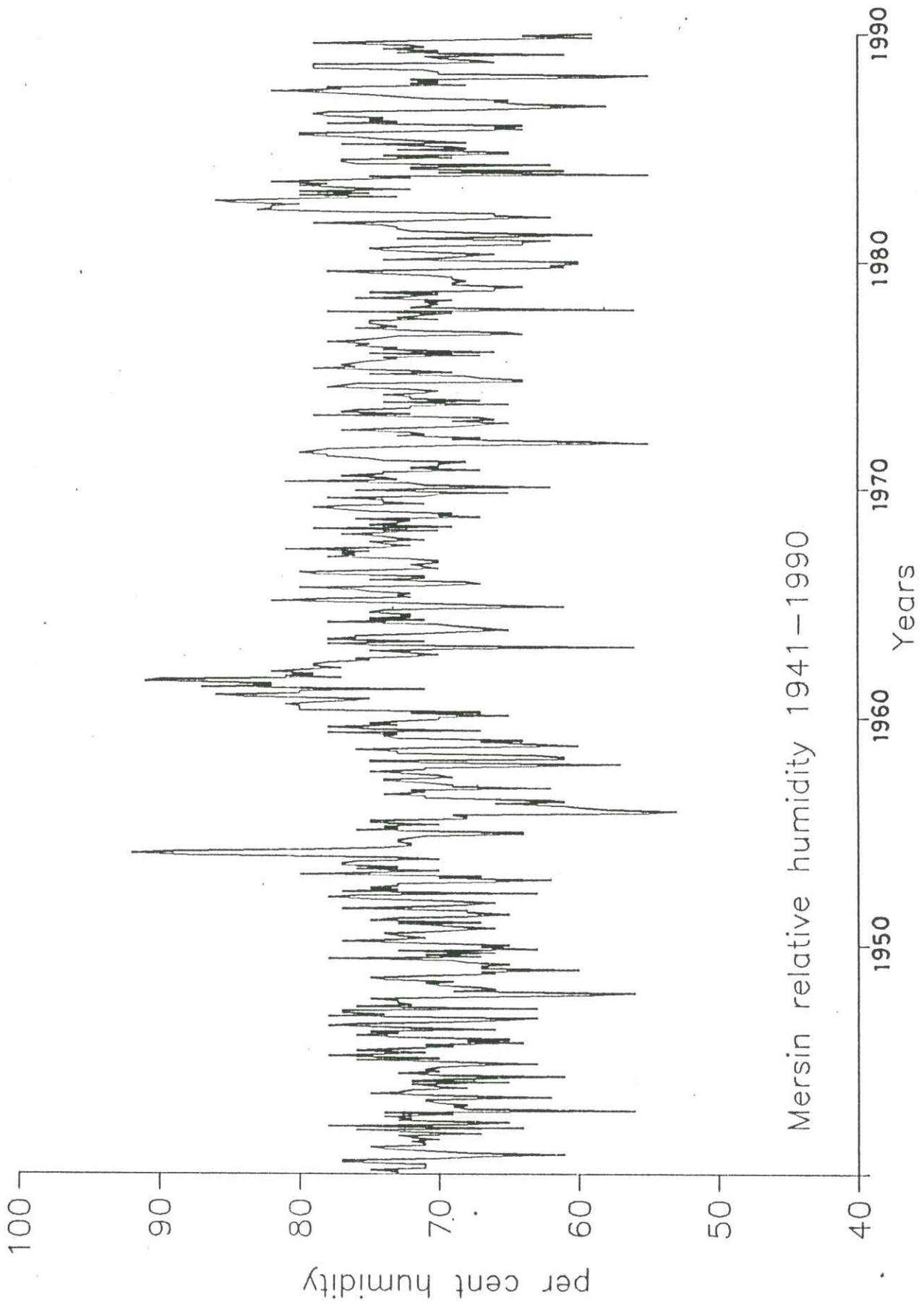




SEKİL. I.50 Deniz yüzeyi sıcaklığı



SEKİL. I. 50 Deniz yüzeyi sıcaklığı



Mersin relative humidity 1941-1990

SEKIL. I. 51 Nispi nem.

TABLO I.1 En hızlı rüzgarlar (wind gust) 1992

Wind speeds greater than 10 m/s are listed below.

Date	Speed	Direction	Date	Speed	Direction
27.1.92	11.4	ENE	8.4.92	15.0	W
30.1.92	11.9	NE	12.4.92	20.7	SSW
27.1.92	10.2	ENE	13.4.92	17.7	SSW
3.2.92	12.5	ENE	20.4.92	21.4	SSW
9.2.92	14.9	ENE	21.4.92	11.7	SSW
20.2.92	18.8	SSW	5.5.92	10.9	NE
22.2.92	12.2	NE	7.5.92	14.2	NE
29.2.92	14.8	ENE	8.5.92	12.2	ENE
13.3.92	11.4	NNE	17.5.92	10.7	WSW
15.3.92	10.8	SW	18.5.92	12.5	WSW
18.3.92	12.8	SSW	5.6.92	19.7	NNW
19.3.92	12.0	WNW	19.6.92	11.0	SSW
21.3.92	14.9	SW	29.6.92	12.0	SW
22.3.92	11.8	NW	1.7.92	11.7	SSW
28.3.92	12.7	NE	2.7.92	10.2	SSW
29.3.92	14.6	SSW	19.8.92	11.0	SW
30.3.92	19.3	W	23.8.92	10.1	SSW
31.3.92	11.7	SW	20.9.92	11.2	SW
			5.10.92	6.6	SSW

(For October, maximum observed wind speed is given)

TABLO I.1 En hızlı rüzgarlar (wind gust) 1992

Wind speeds greater than 10 m/s are listed below.

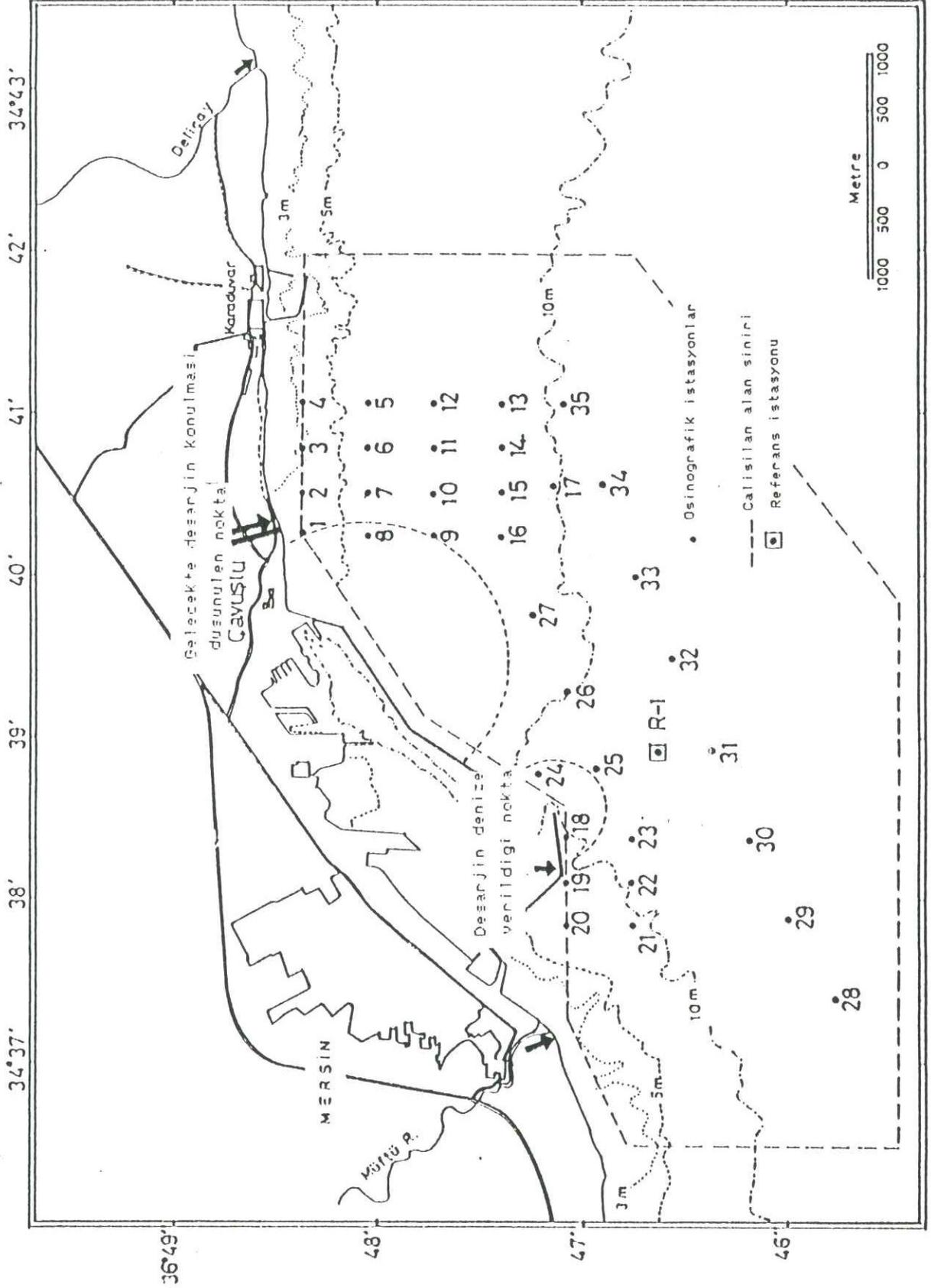
Date	Speed	Direction	Date	Speed	Direction
27.1.92	11.4	ENE	8.4.92	15.0	W
30.1.92	11.9	NE	12.4.92	20.7	SSW
27.1.92	10.2	ENE	13.4.92	17.7	SSW
3.2.92	12.5	ENE	20.4.92	21.4	SSW
9.2.92	14.9	ENE	21.4.92	11.7	SSW
20.2.92	18.8	SSW	5.5.92	10.9	NE
22.2.92	12.2	NE	7.5.92	14.2	NE
29.2.92	14.8	ENE	8.5.92	12.2	ENE
13.3.92	11.4	NNE	17.5.92	10.7	WSW
15.3.92	10.8	SW	18.5.92	12.5	WSW
18.3.92	12.8	SSW	5.6.92	19.7	NNW
19.3.92	12.0	WNW	19.6.92	11.0	SSW
21.3.92	14.9	SW	29.6.92	12.0	SW
22.3.92	11.8	NW	1.7.92	11.7	SSW
28.3.92	12.7	NE	2.7.92	10.2	SSW
29.3.92	14.6	SSW	19.8.92	11.0	SW
30.3.92	19.3	W	23.8.92	10.1	SSW
31.3.92	11.7	SW	20.9.92	11.2	SW
			5.10.92	6.6	SSW

(For October, maximum observed wind speed is given)

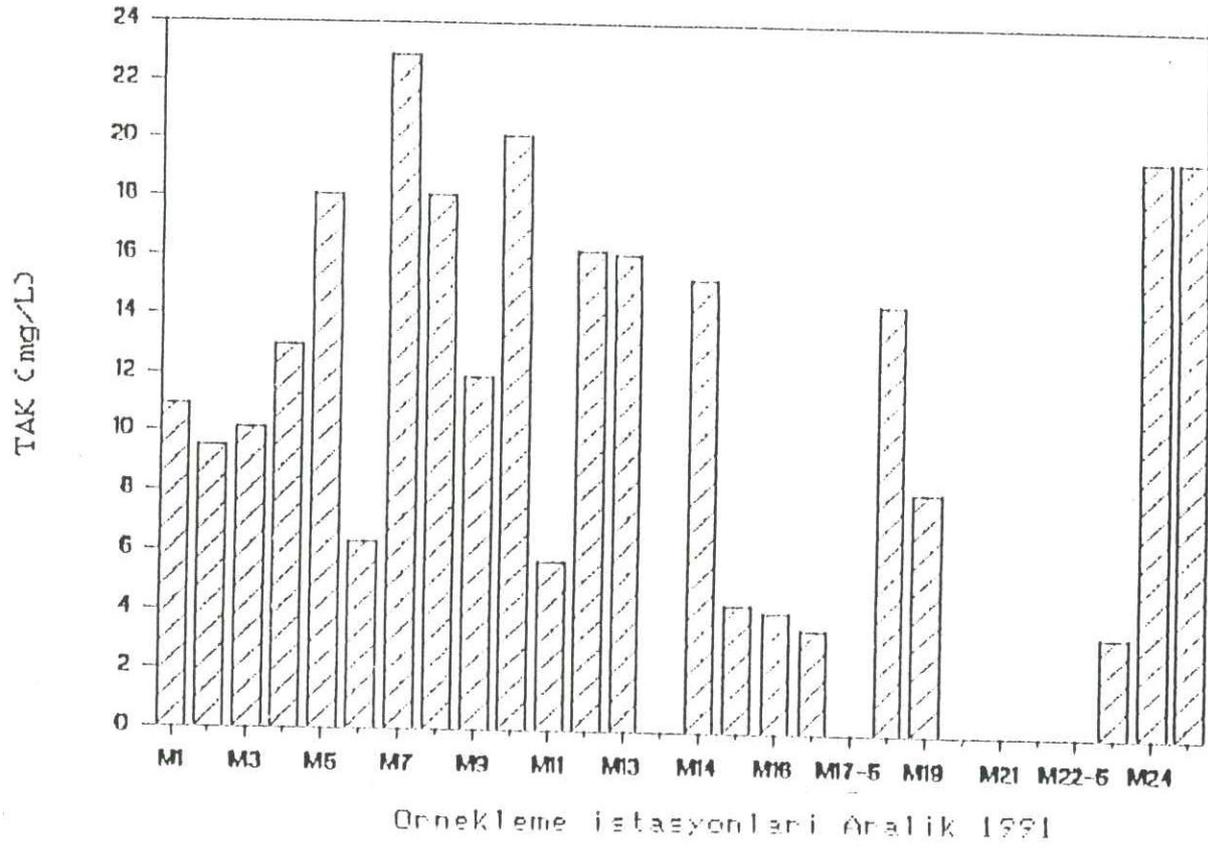
ortalama nispi nem oranları 1941-1990

TABLO I.2

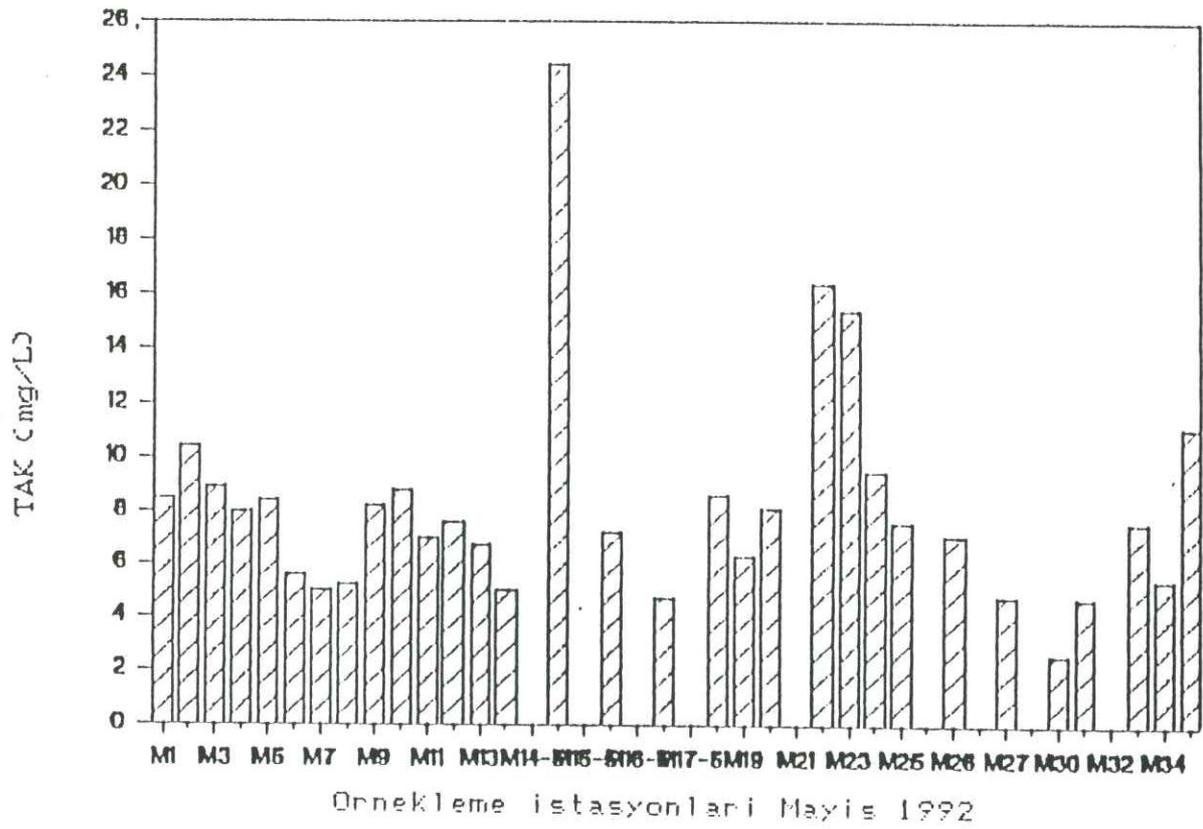
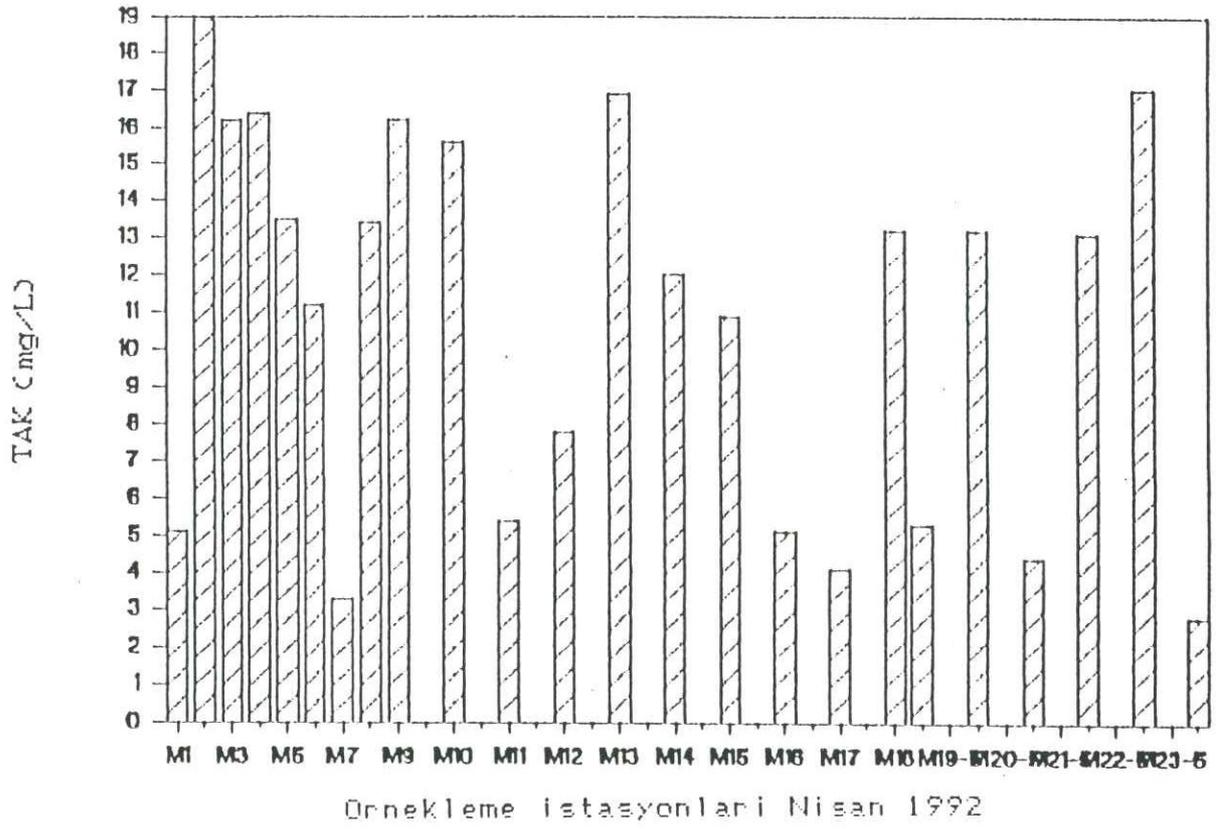
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1941	75	71	71	71	71	77	77	70	67	61	68	71
1942	68	65	71	73	72	74	72	73	67	72	76	64
1943	71	71	62	69	75	73	69	74	56	68	69	68
1944	69	61	70	73	70	70	71	72	68	70	72	65
1945	70	78	75	71	76	73	69	70	68	63	70	76
1946	76	73	75	66	72	78	76	71	64	68	65	73
1947	77	77	63	76	72	73	76	69	65	63	78	74
1948	66	67	70	71	69	74	73	75	68	59	56	69
1949	67	65	68	69	78	67	75	71	66	67	60	67
1950	70	77	73	71	73	74	71	66	73	63	67	65
1951	75	73	68	65	68	74	71	68	66	69	73	67
1952	78	76	63	77	73	68	77	72	68	66	69	67
1953	80	75	70	76	73	75	73	73	66	62	69	75
1954	89	79	74	72	72	77	77	76	70	73	70	67
1955	73	74	70	75	73	73	73	72	71	64	88	92
1956	61	66	61	62	71	68	68	69	55	53	64	76
1957	71	74	74	69	70	71	74	71	72	62	58	60
1958	75	61	61	63	73	72	75	71	71	63	69	69
1959	73	74	73	78	67	73	76	71	60	63	57	75
1960	65	72	67	80	80	75	78	73	75	63	67	64
1961	80	80	71	87	80	80	81	79	76	73	70	70
1962	80	77	79	87	82	82	91	90	77	75	84	86
1963	80	75	78	79	78	75	76	72	77	81	79	82
1964	56	78	71	71	78	76	76	70	70	72	75	69
1965	70	78	71	75	72	72	75	74	68	65	67	69
1966	82	78	72	73	72	75	76	80	70	61	68	73
1967	71	71	79	80	75	70	71	72	71	67	68	75
1968	76	77	75	81	74	72	74	75	70	70	72	78
1969	74	70	79	69	75	73	72	76	71	73	74	77
1970	77	79	77	71	74	74	78	67	70	70	69	75
1971	62	71	72	81	73	74	77	71	70	65	76	71
1972	70	68	74	75	78	74	74	74	74	67	72	70
1973	59	69	67	73	71	78	80	79	78	74	69	55
1974	66	67	79	72	77	72	77	74	69	67	65	69
1975	72	74	71	70	72	76	72	72	65	74	67	72
1976	75	69	72	79	76	77	77	76	64	64	67	68
1977	66	74	73	76	75	77	76	75	73	74	67	75
1978	76	73	74	75	75	70	76	74	73	64	65	71
1979	71	70	71	69	76	72	73	71	69	78	56	72
1980	69	68	69	69	71	75	70	75	66	66	64	69
1981	74	70	68	66	70	74	78	70	61	62	60	60
1982	66	59	67	72	73	73	75	72	64	64	62	73
1983	66	77	83	82	82	74	79	73	73	68	62	66
1984	80	72	76	80	80	85	86	80	73	62	66	66
1985	72	72	62	76	77	82	79	72	75	80	75	61
1986	69	77	68	71	74	77	69	75	65	70	68	68
1987	78	73	75	74	78	76	80	72	64	73	66	64
1988	65	71	73	75	78	79	78	62	58	64	66	66
1989	58	55	70	70	71	82	77	68	72	70	72	71
1990	61	73	70	74	71	79	79	66	67	70	71	59



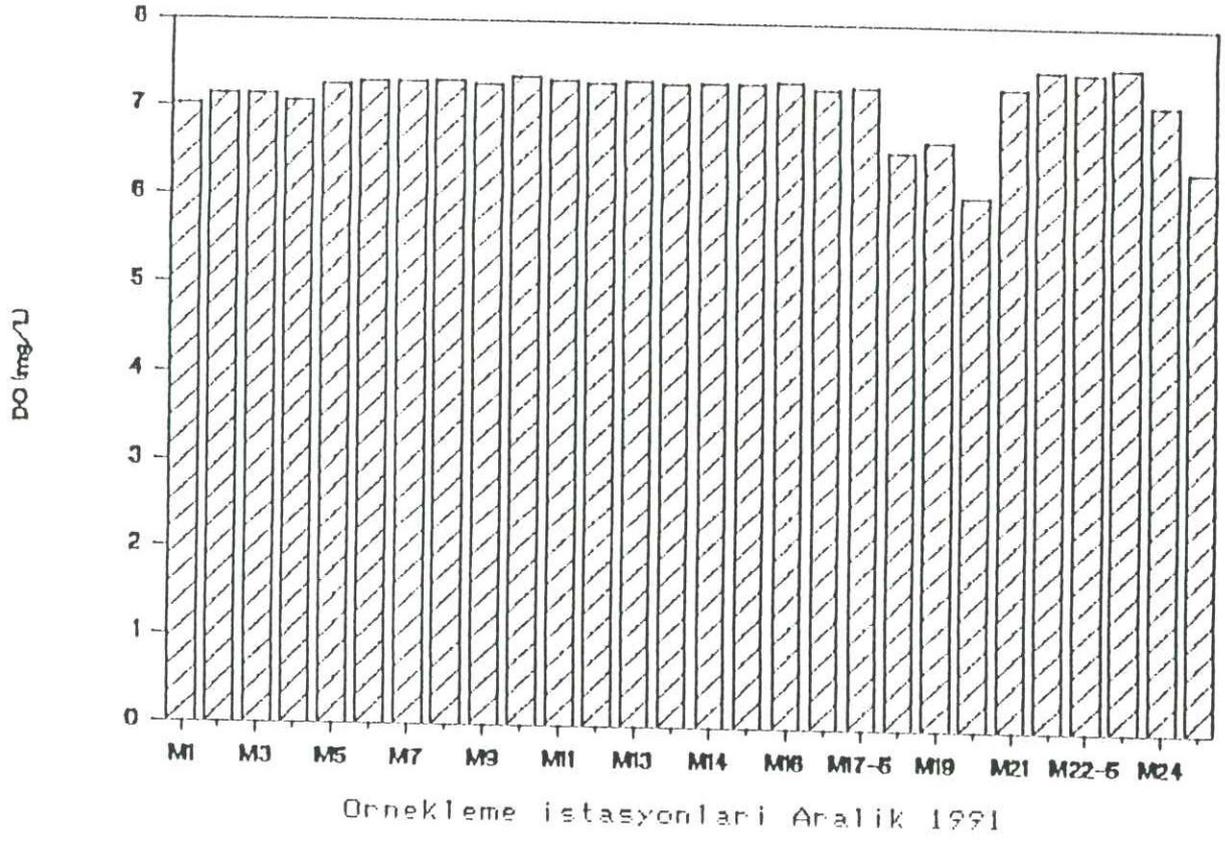
ŞEKİL II.1.1. Mersin körfezinde çalışan istasyonlar



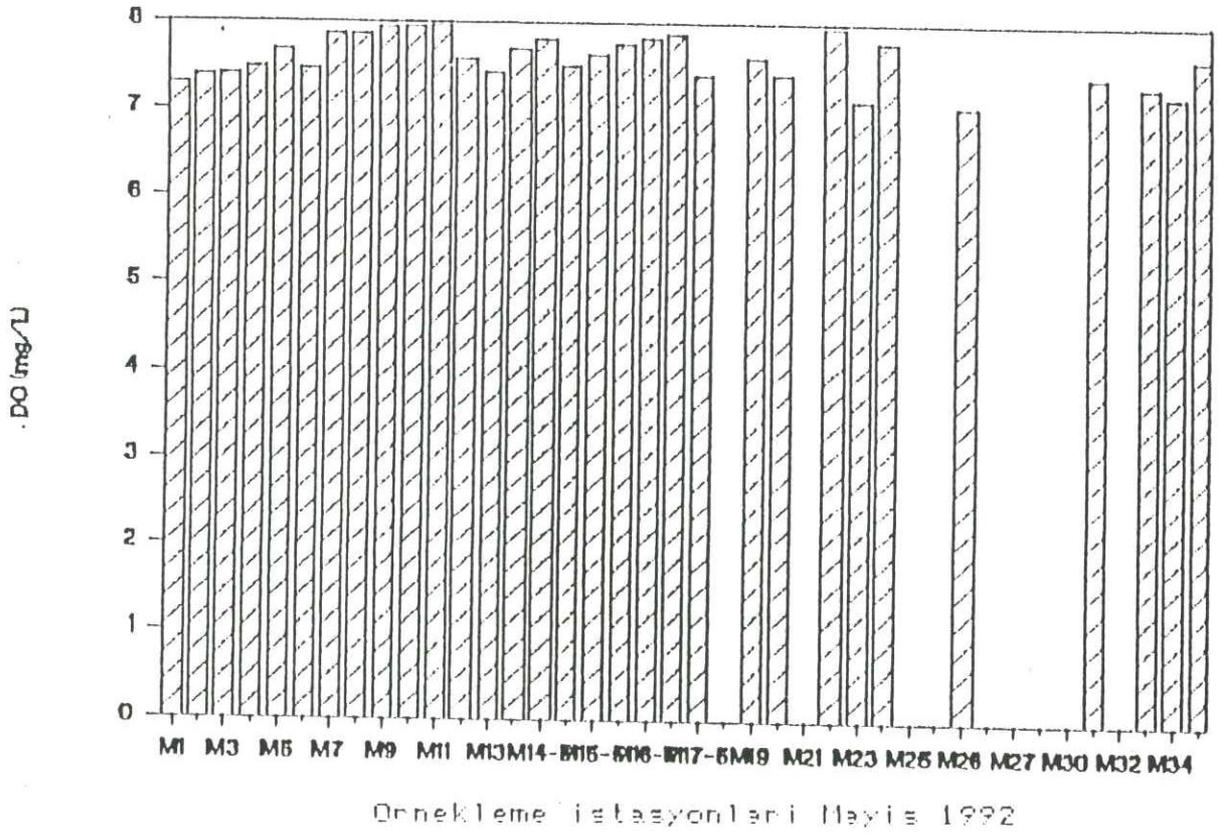
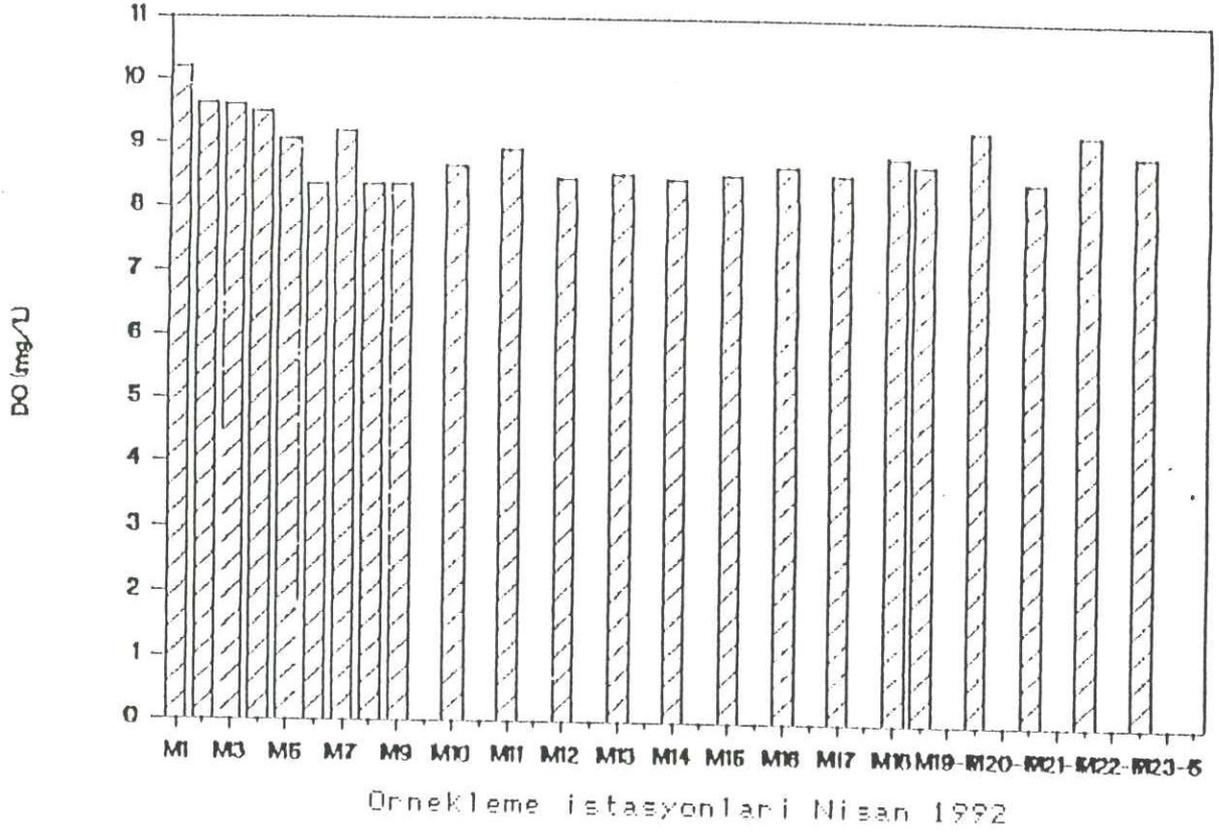
ŞEKİL II.2. Analik 1991-Ekim 1992 tarihleri arasında Mersin Körfezinde ölçülen toplam aski maddenin (TSS) mevsimlik değişimi



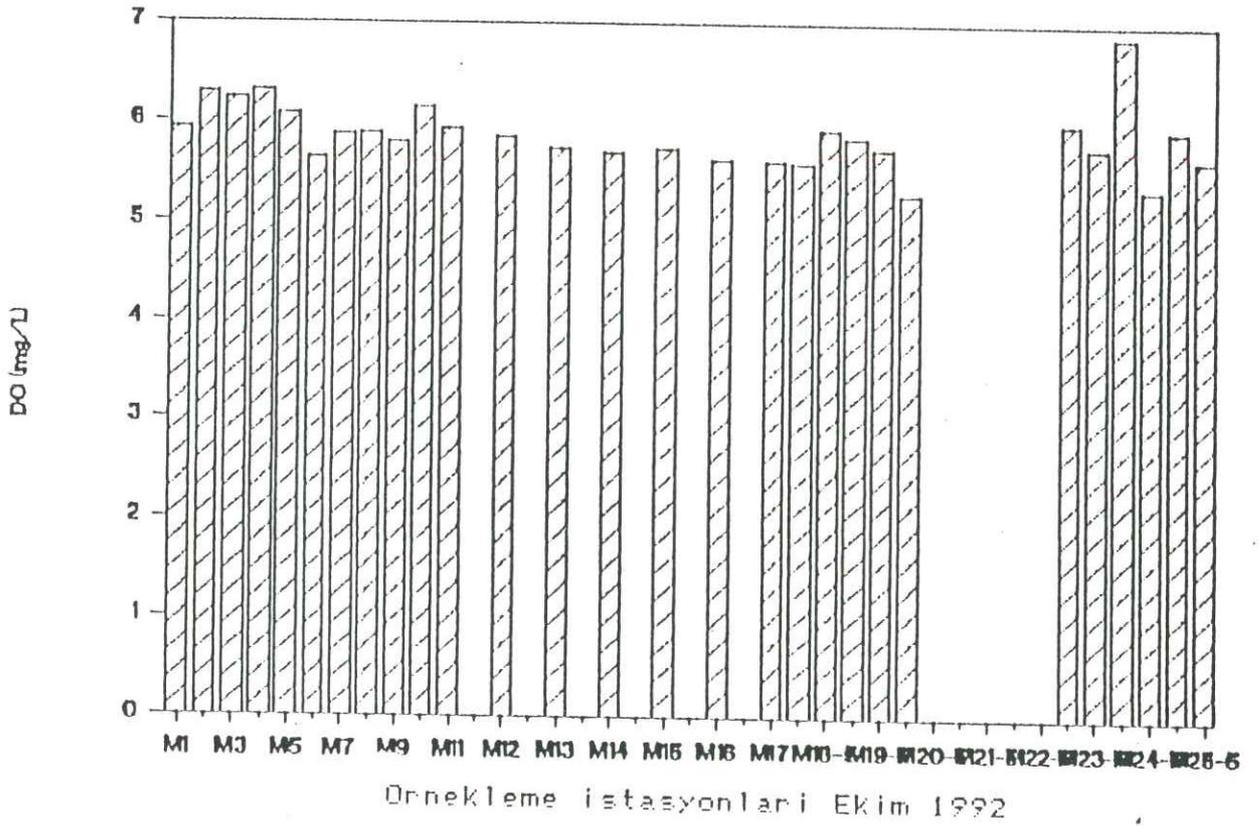
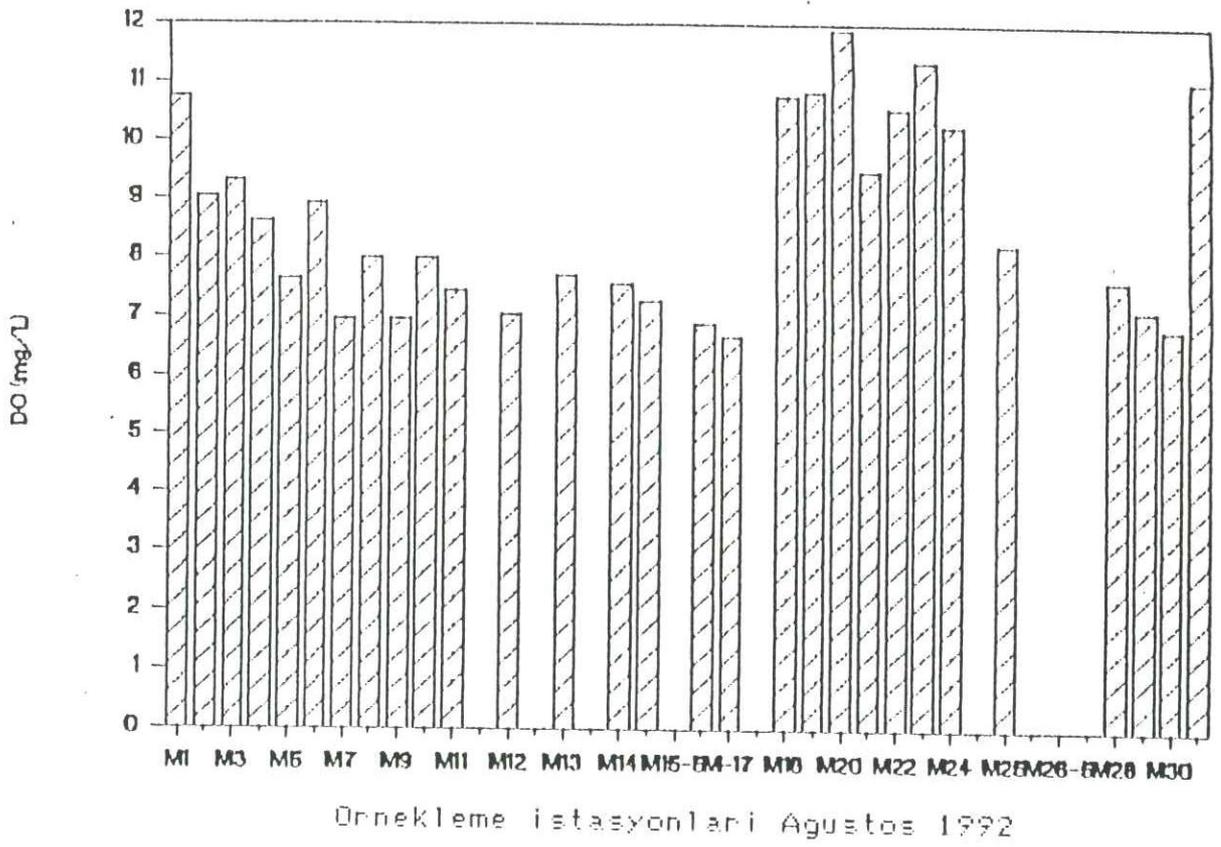
ŞEKİL II.2.



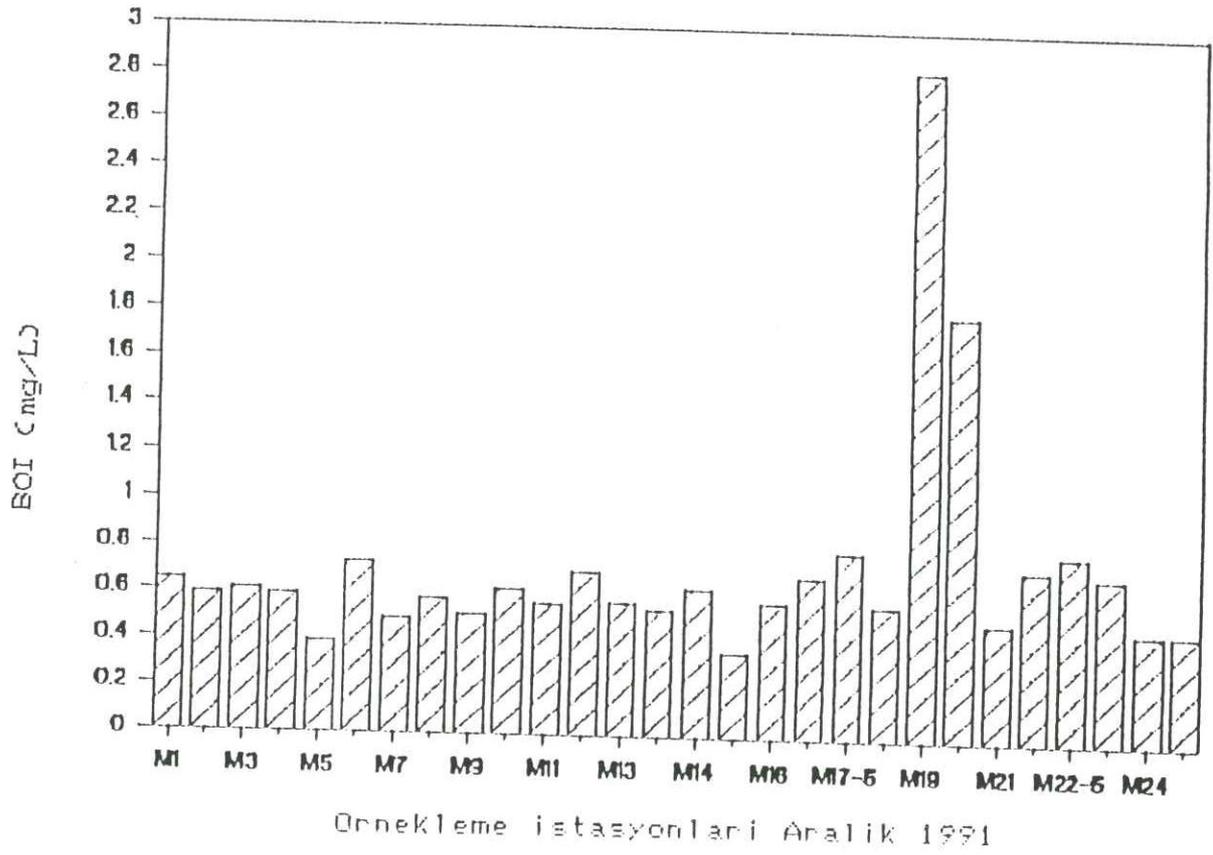
SEKIL II.3. Analik 1991-Ekim 1992 tarihleri arasinda Mersin Korfezinde olculen cozunmus oksijenin mevsimlik degisimi



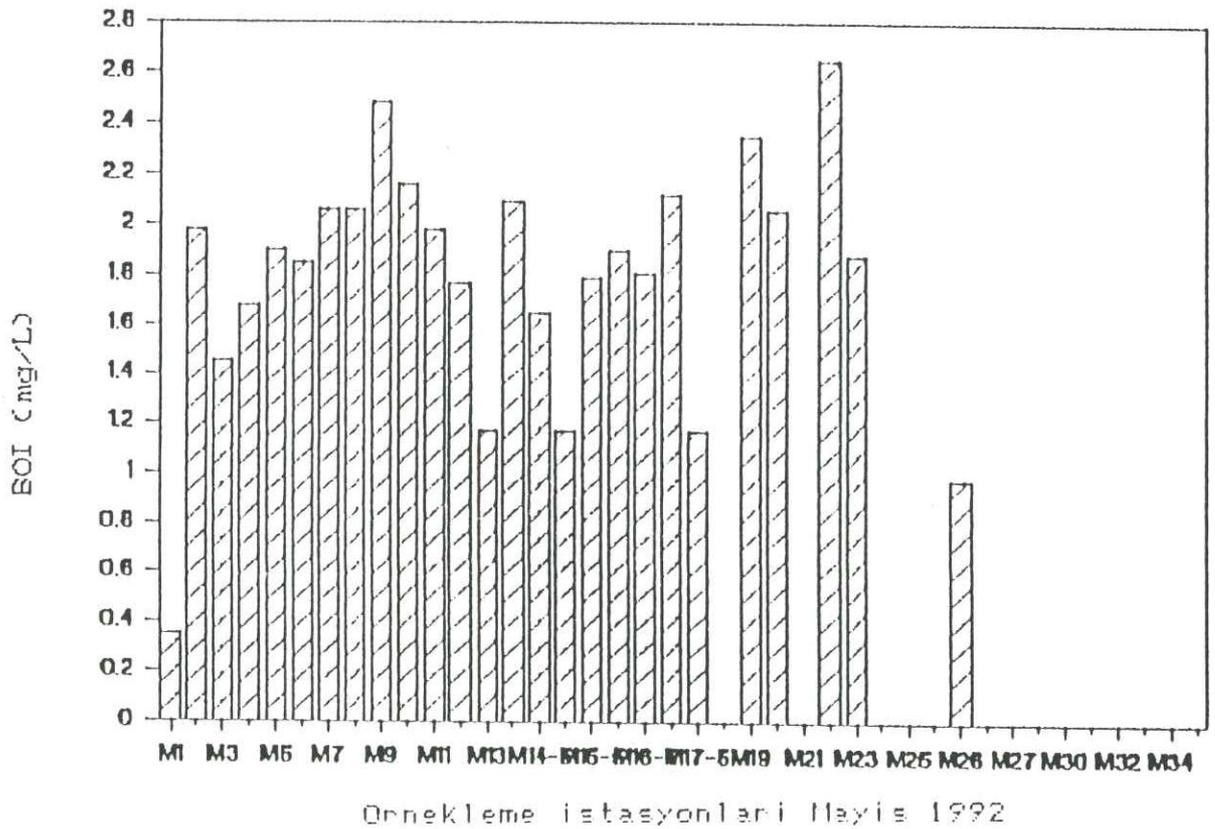
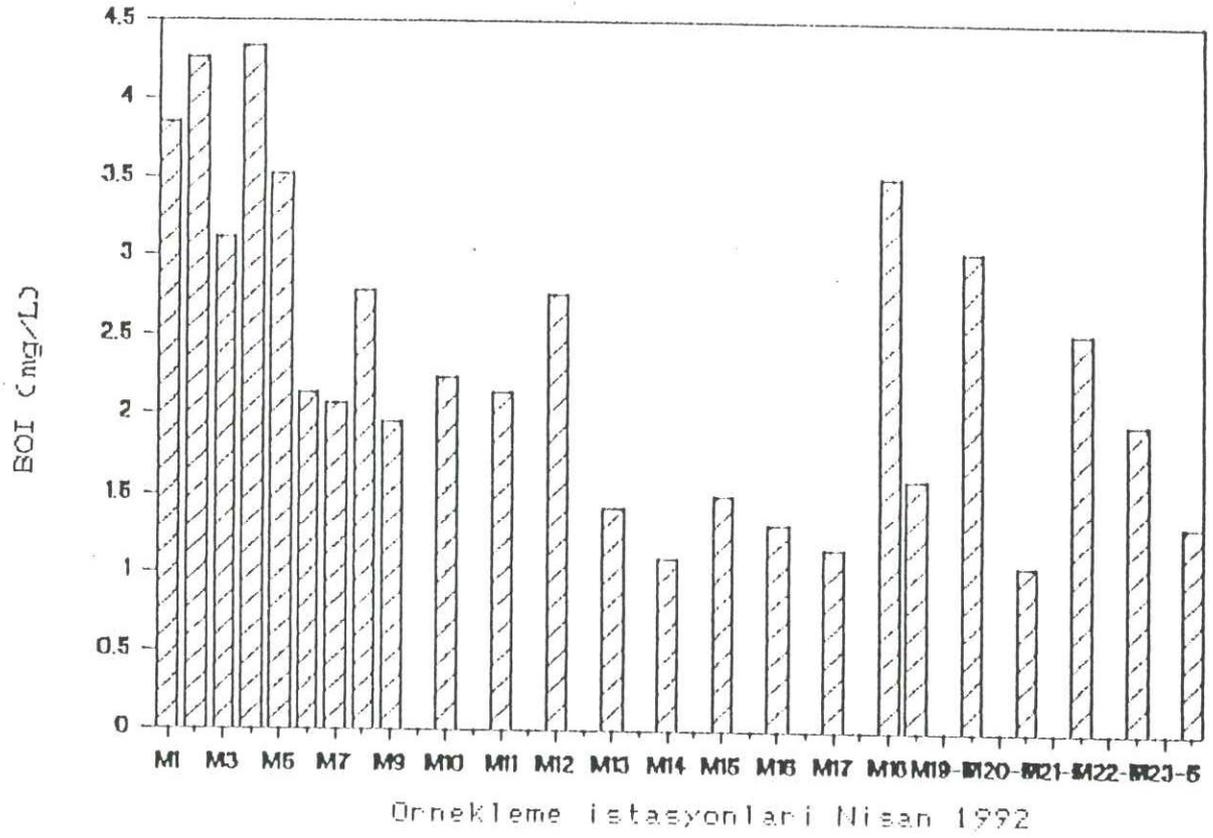
ŞEKİL II.3.



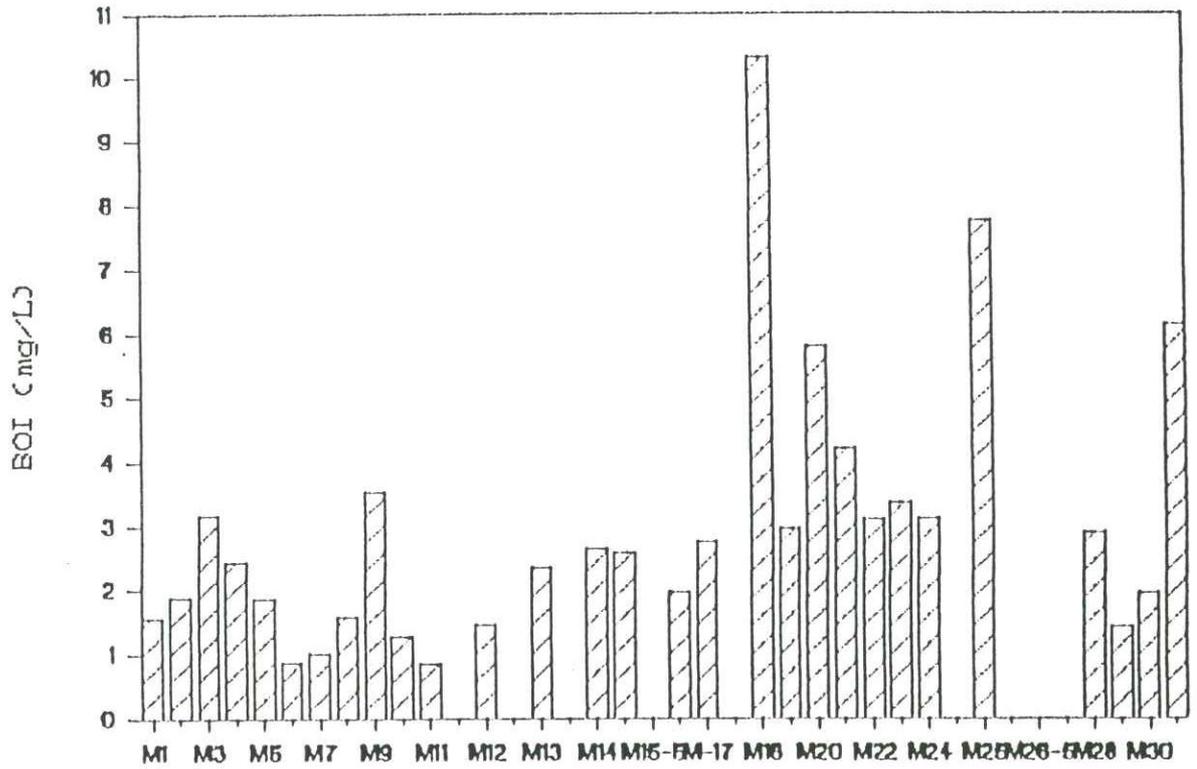
ŞEKİL II. 3.



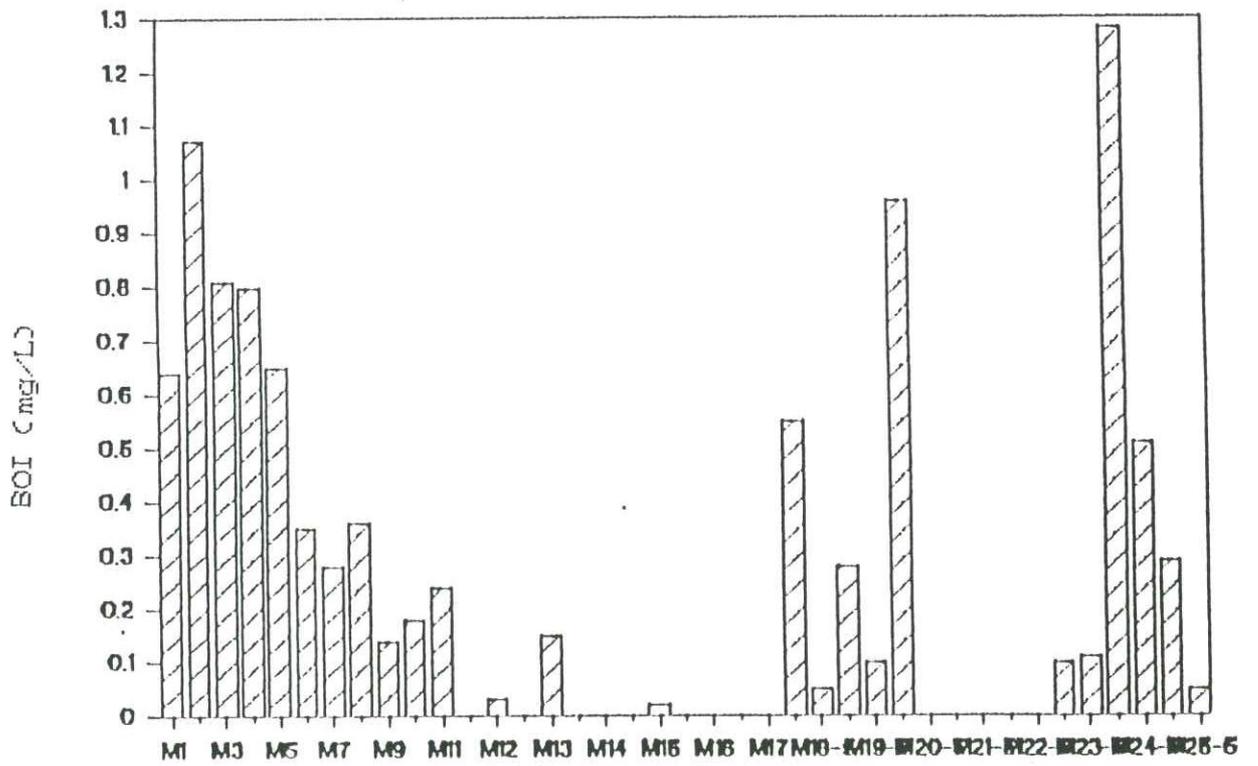
SEKIL II.4. Analik 1991-Ekim 1992 tarihleri arasında Mersin Körfezinde ölçülen biyolojik oksijen ihtiyacı (BOİS) nin mevsimlik değişimi



ŞEKİL II.4.

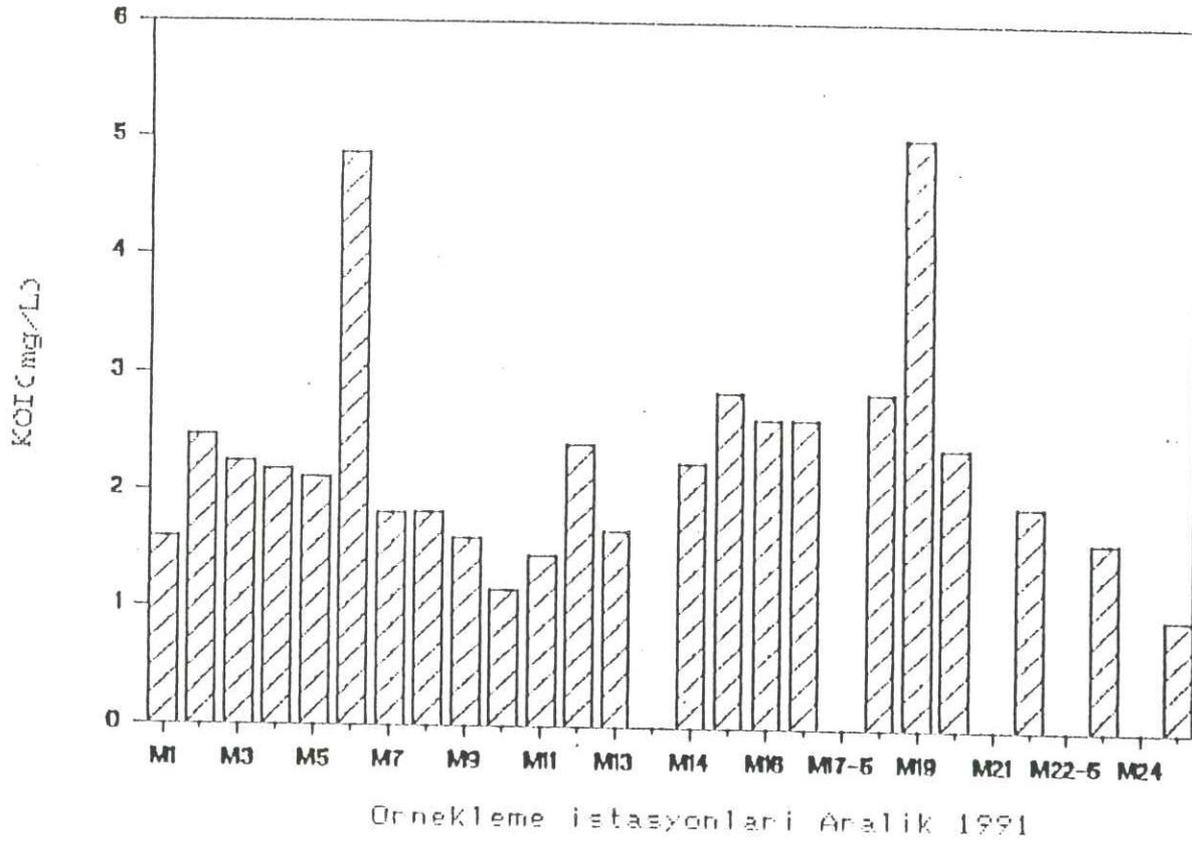


Ornekleme istasyonlari Agustos 1992

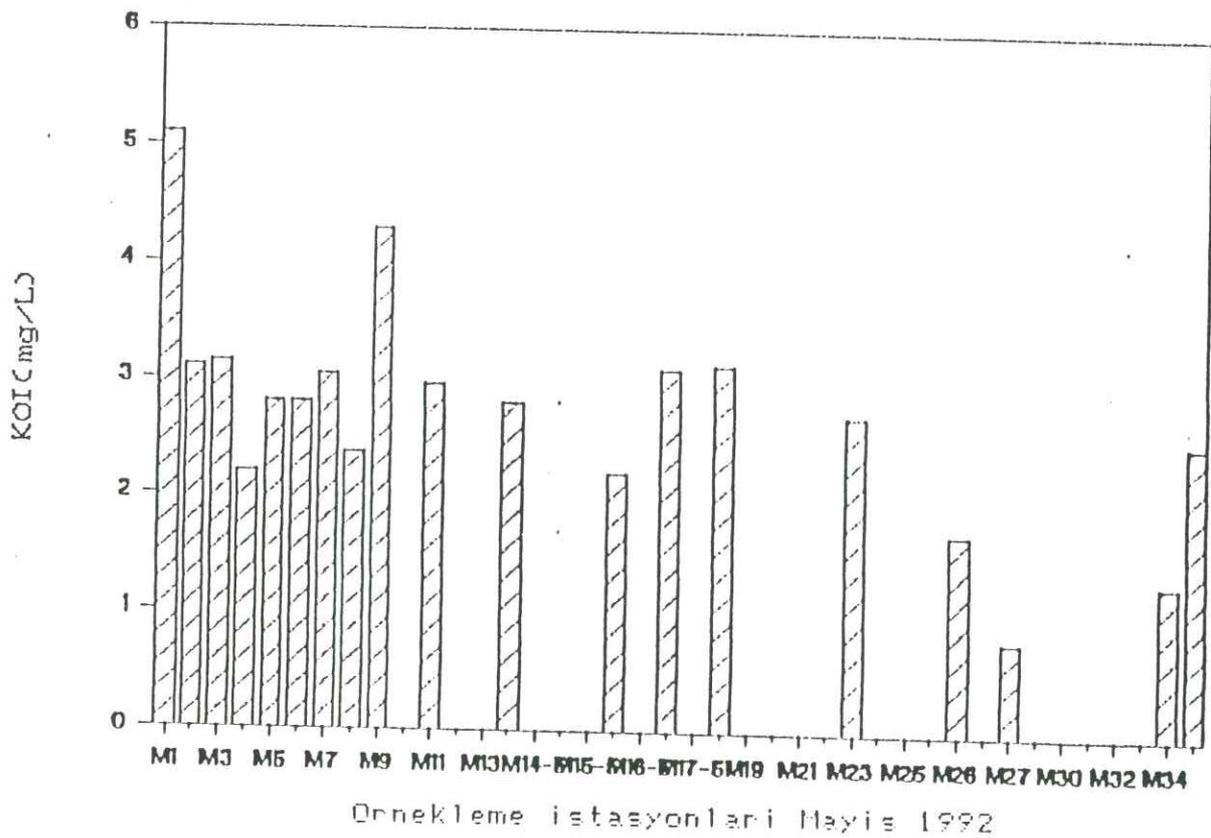
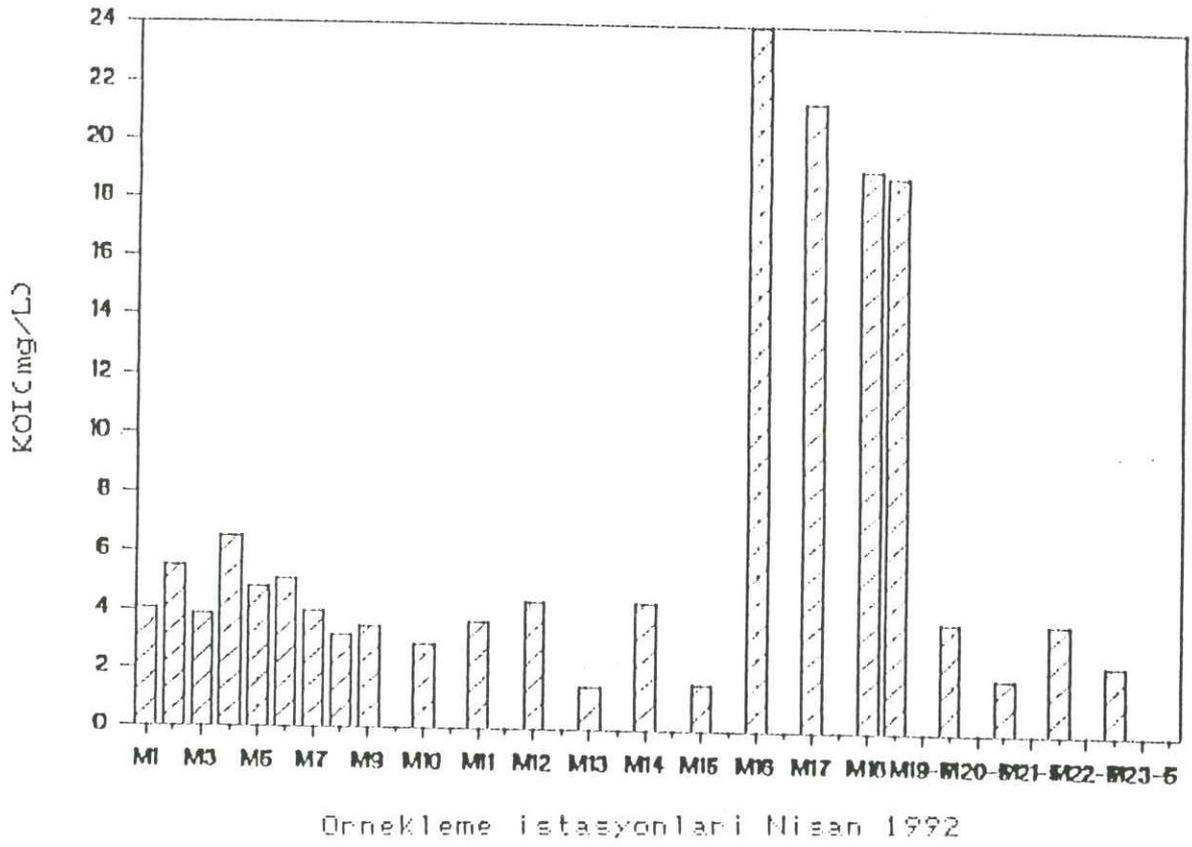


Ornekleme istasyonlari Ekim 1992

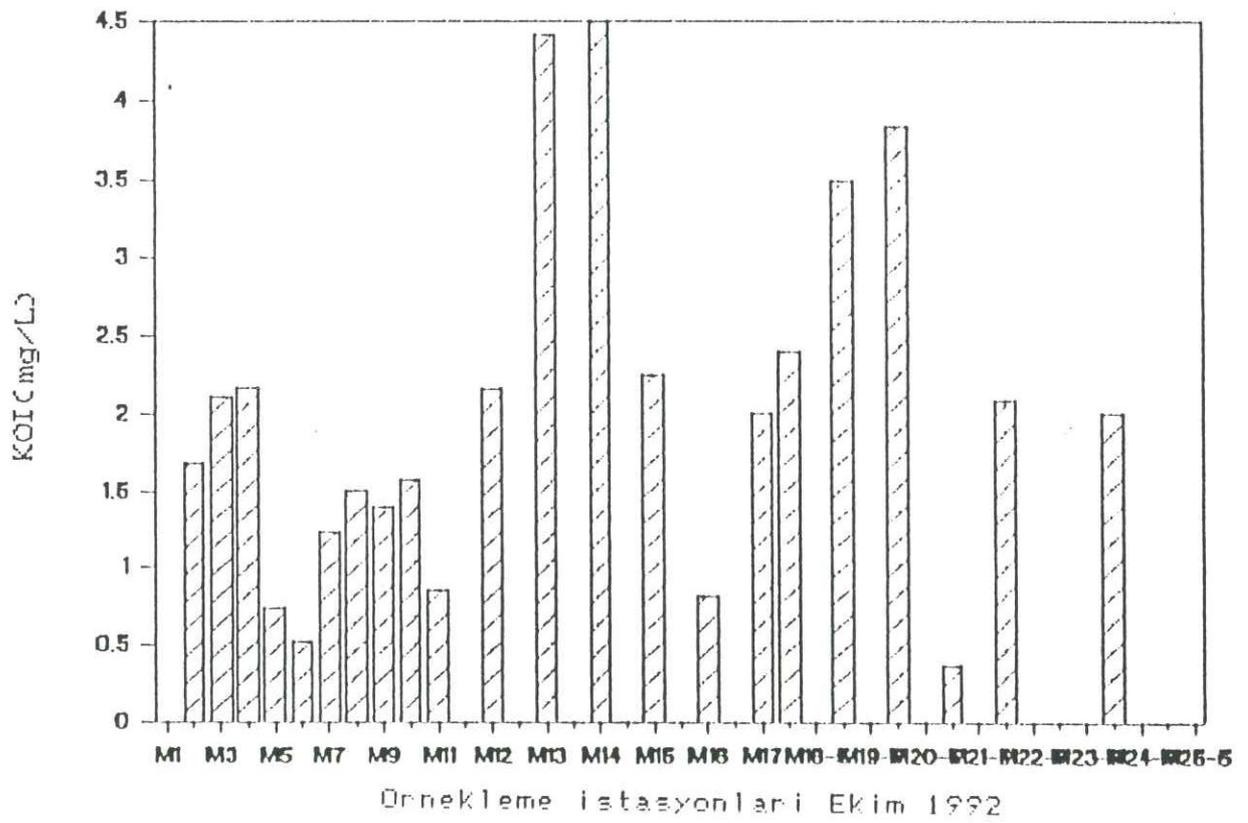
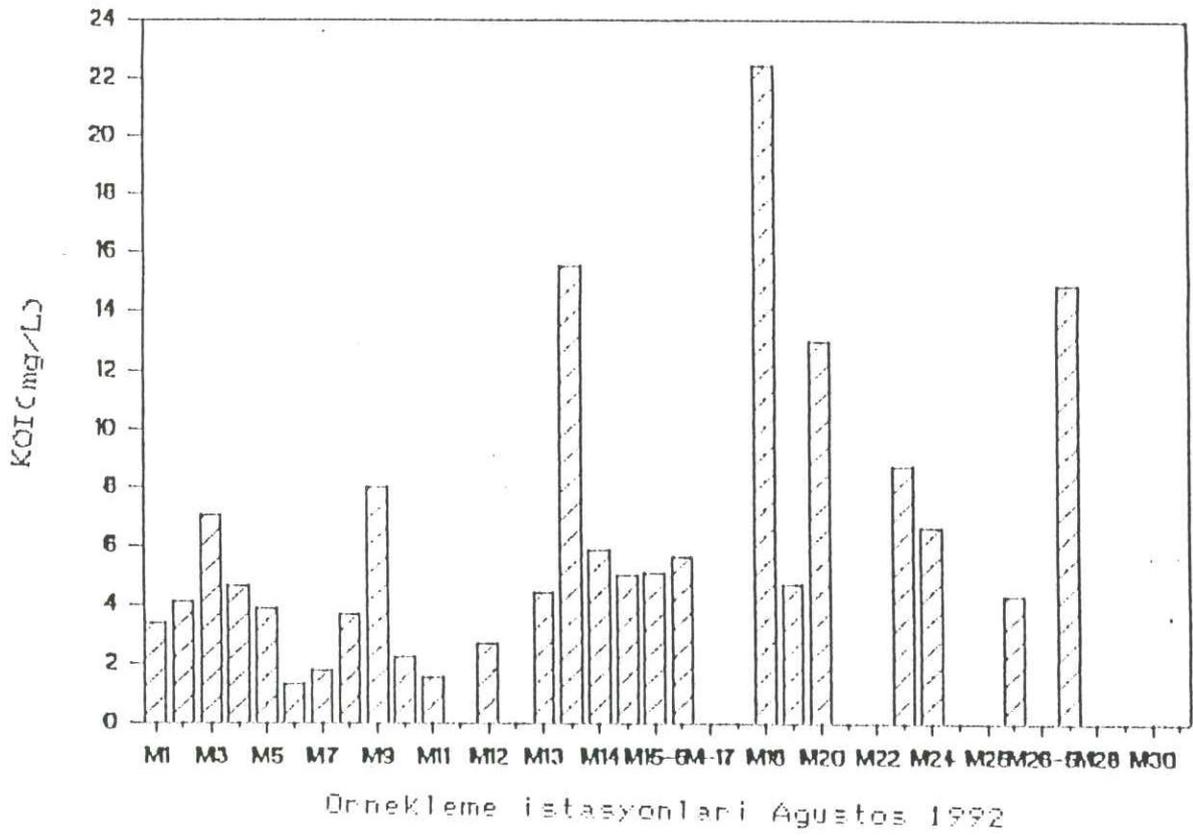
ŞEKİL II.4.



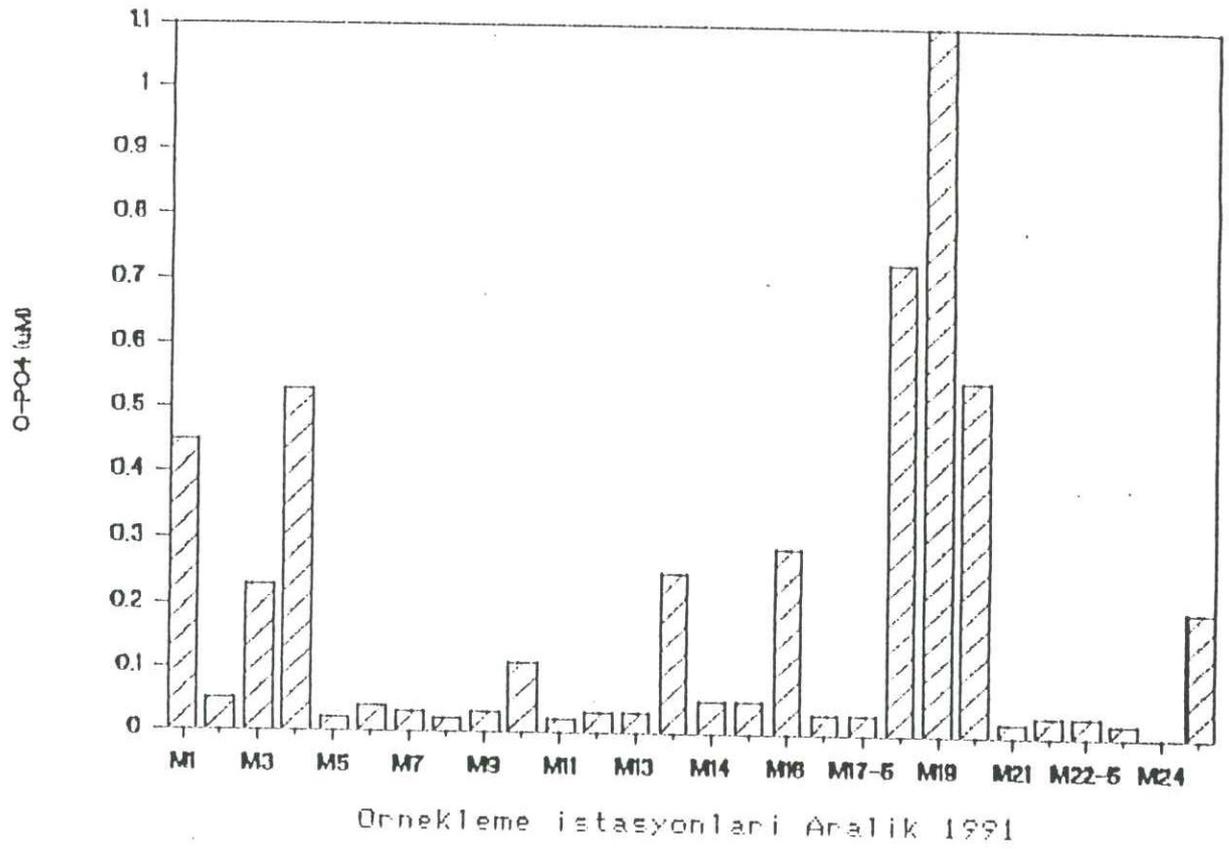
SEKIL II.5. Analik 1991-Ekim 1992 tarihleri arasında Mersin konfezinde ölçülen kimyasal oksijen ihtiyacının (KOD) mevsimlik değişimi



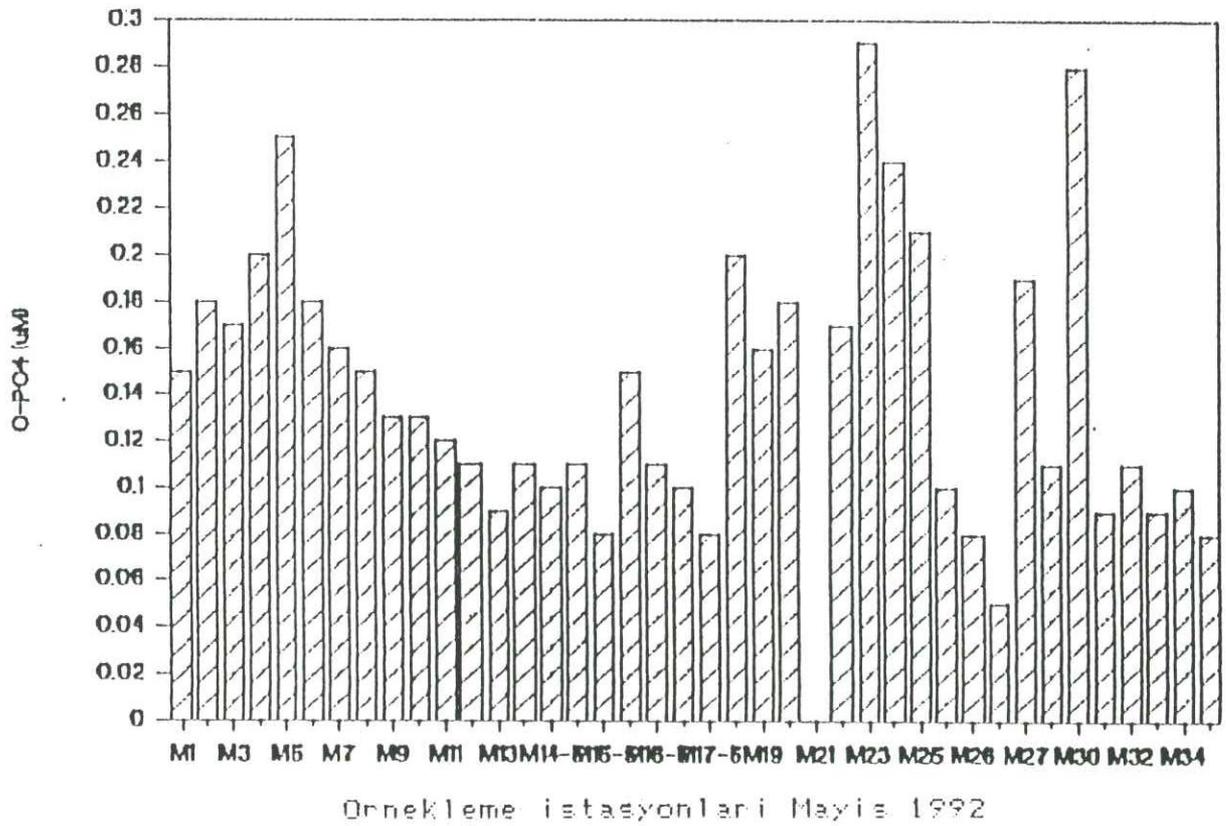
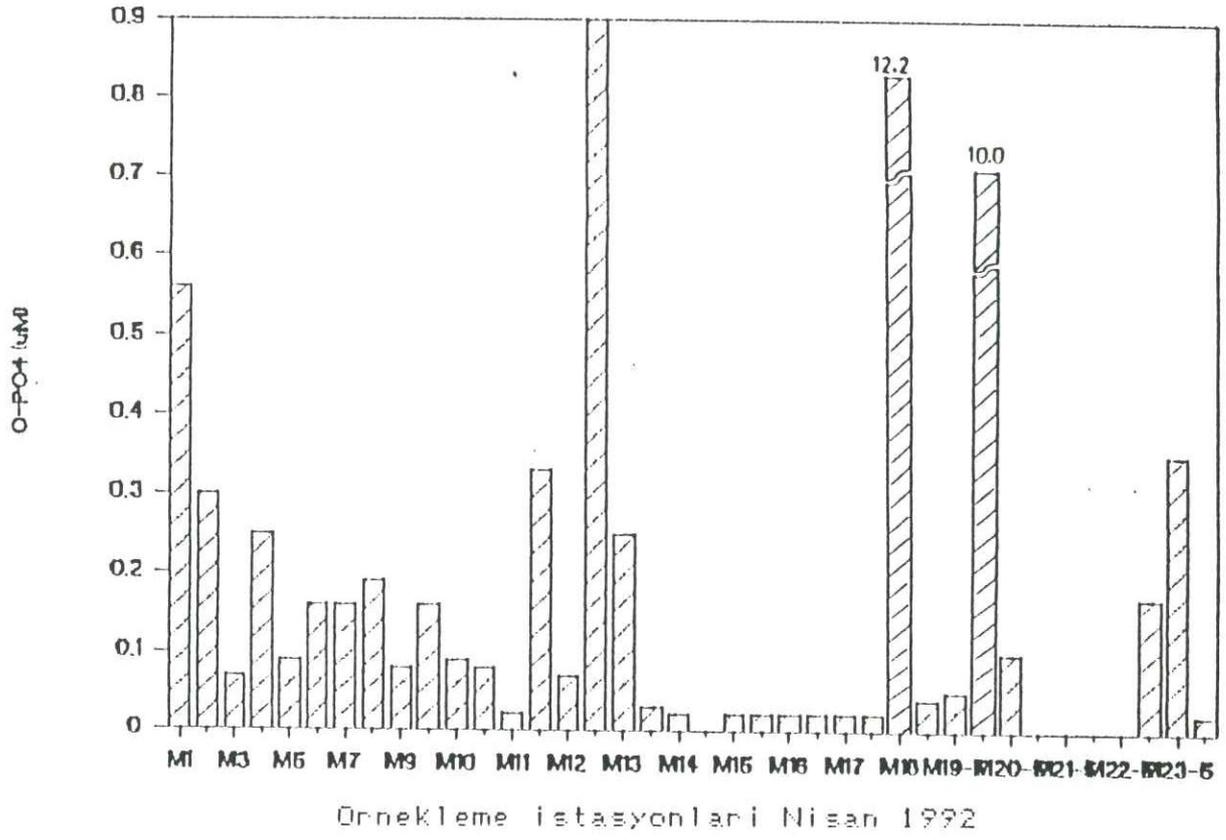
ŞEKİL II.5.



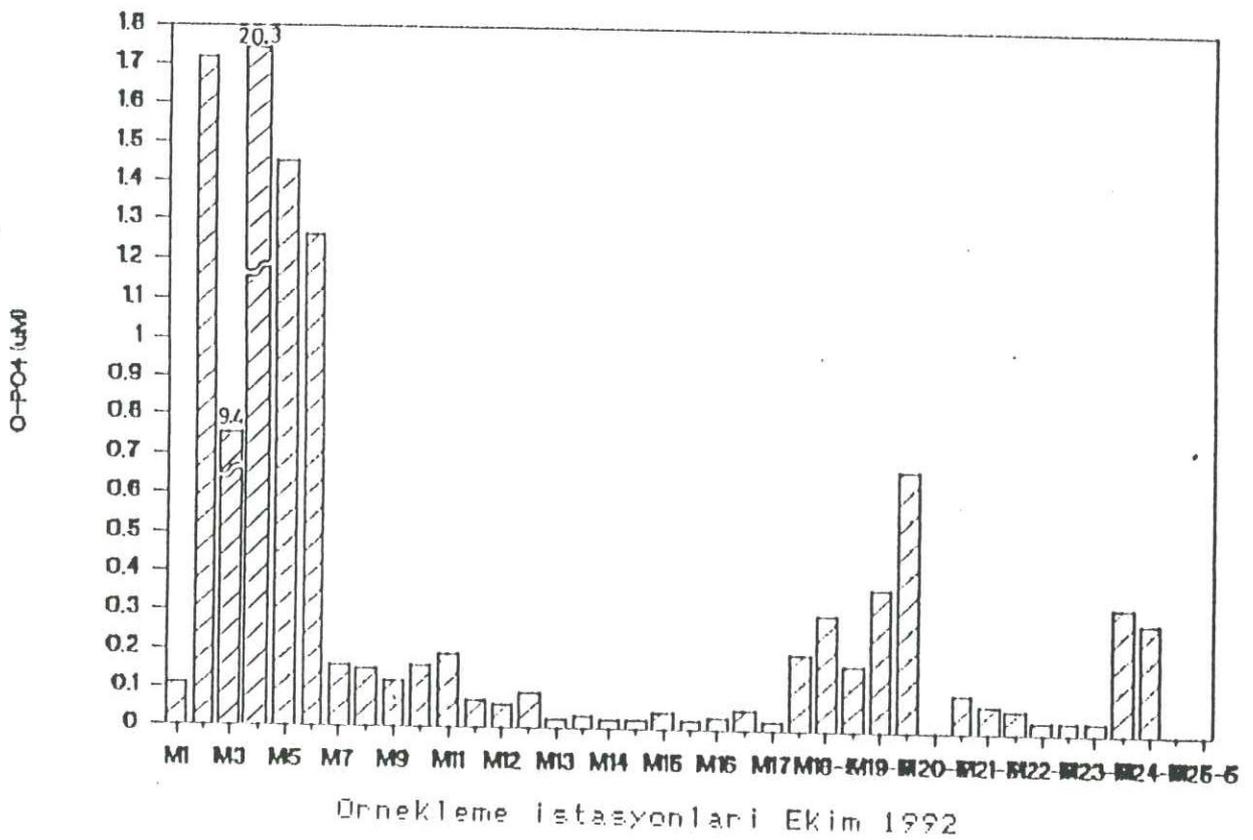
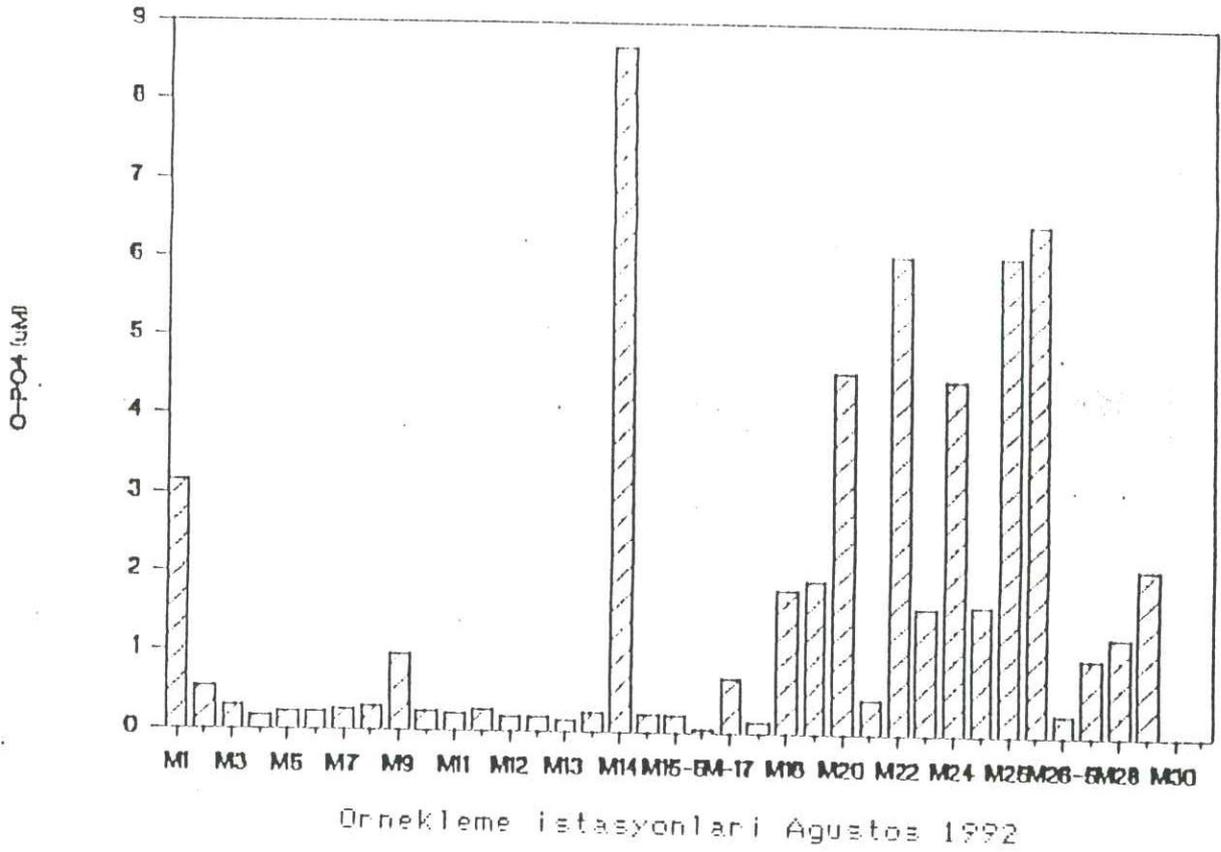
ŞEKİL II.5.



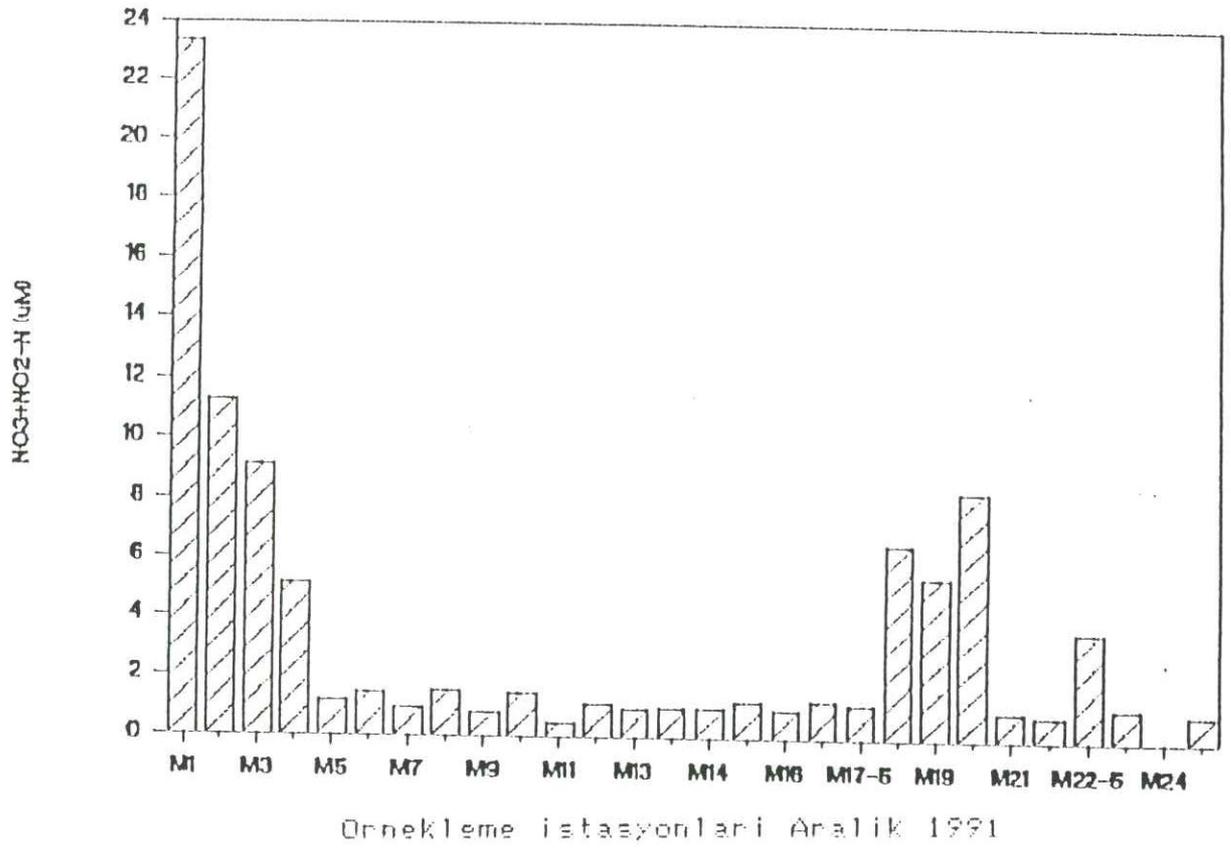
SEKIL II.6. Analik 1991-Ekim 1992 tarihleri arasinda Mersin konfezinde olculen inorganik fosfatin mevsimsel degisimi



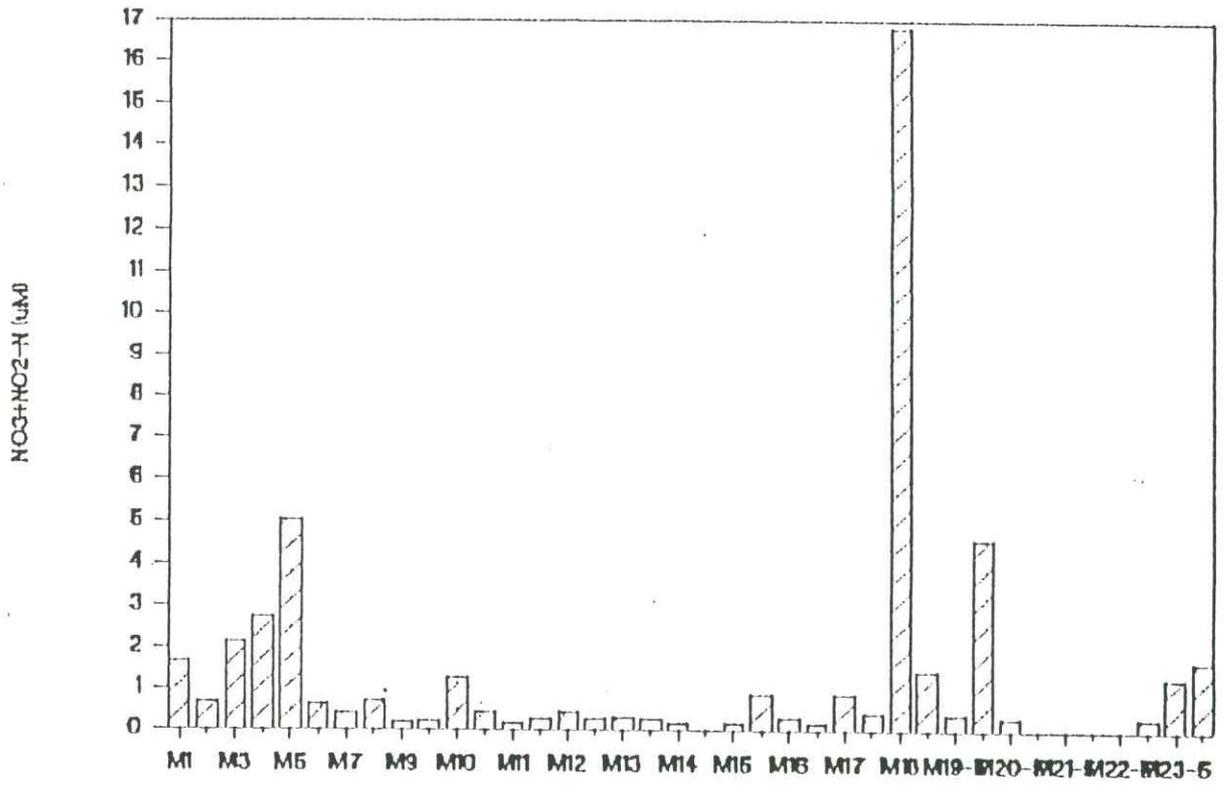
ŞEKİL II.6.



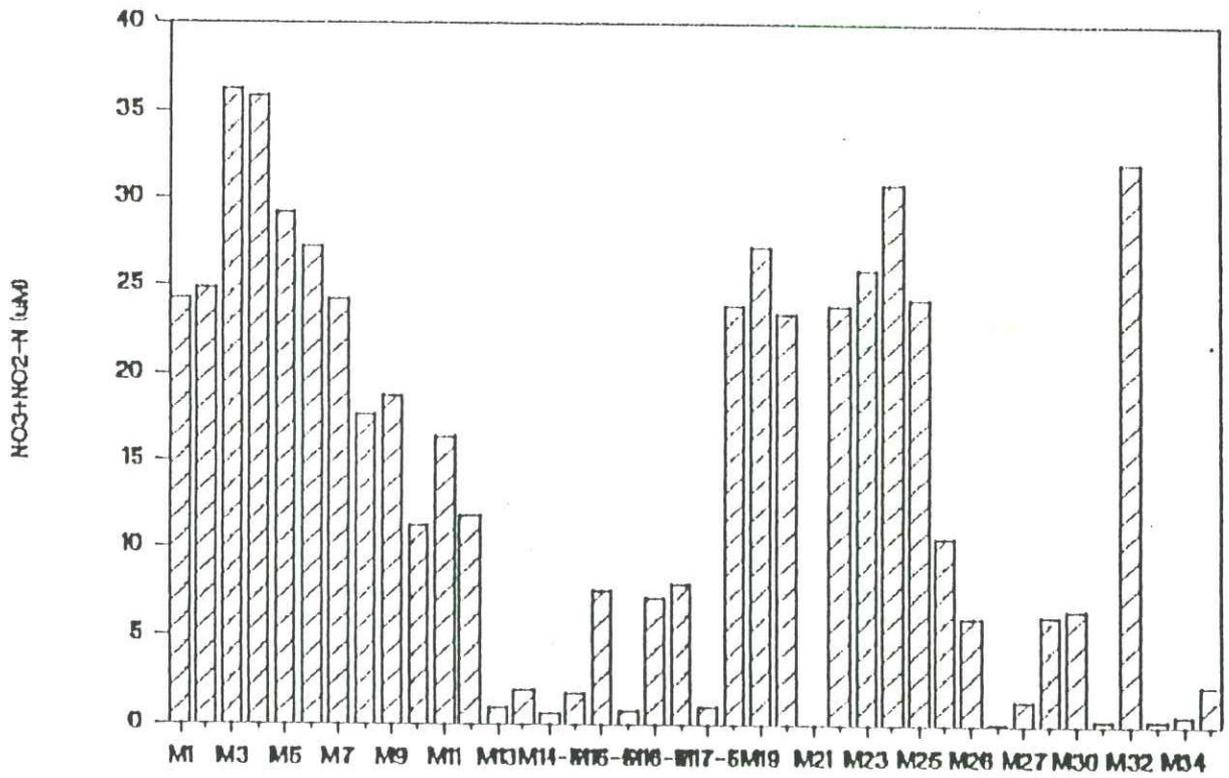
ŞEKİL II.6.



SEKIL II.7. Analik 1991-Ekim 1992 tarihleri arasında Mersin Körfezinde ölçülen oksitlenmiş azot'un (NO₃+NO₂) mevsimsel değişimi

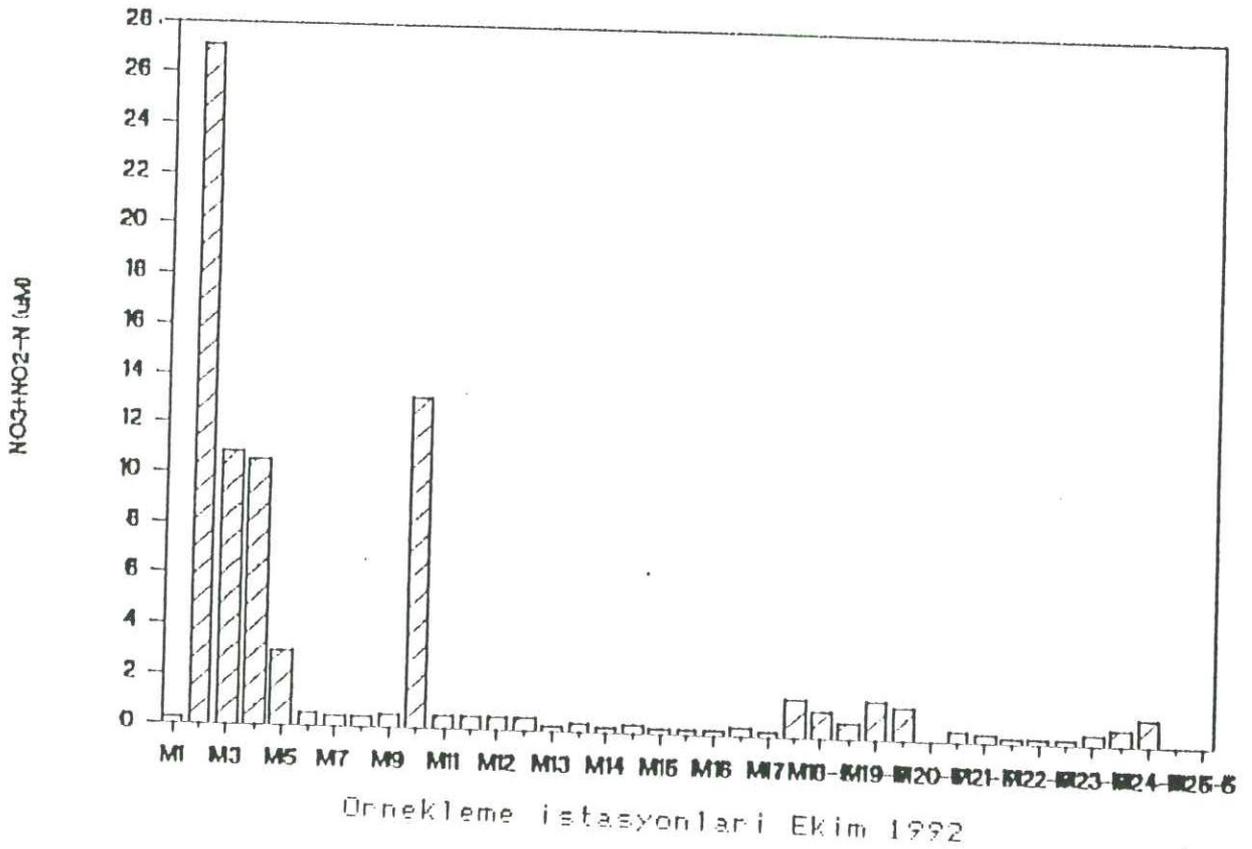
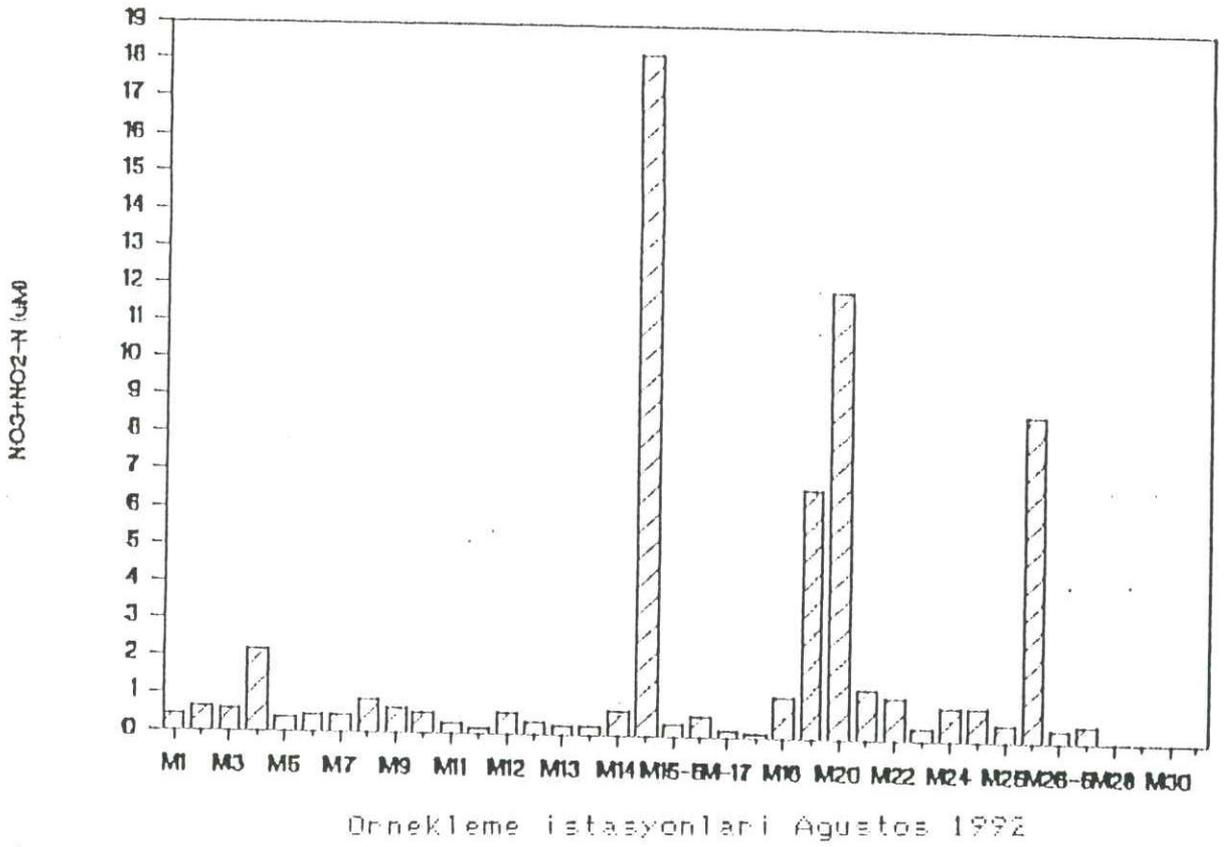


Örnekleme istasyonları Nisan 1992

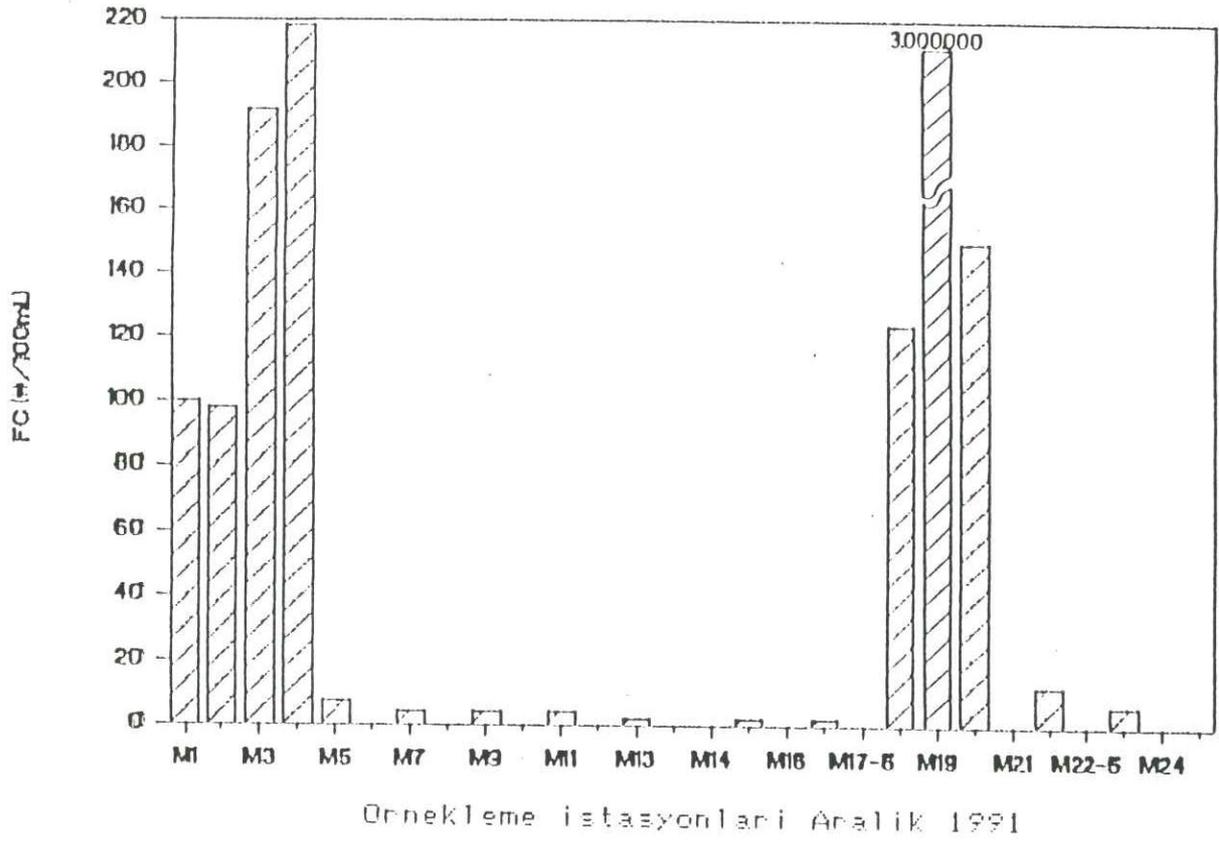


Örnekleme istasyonları Mayıs 1992

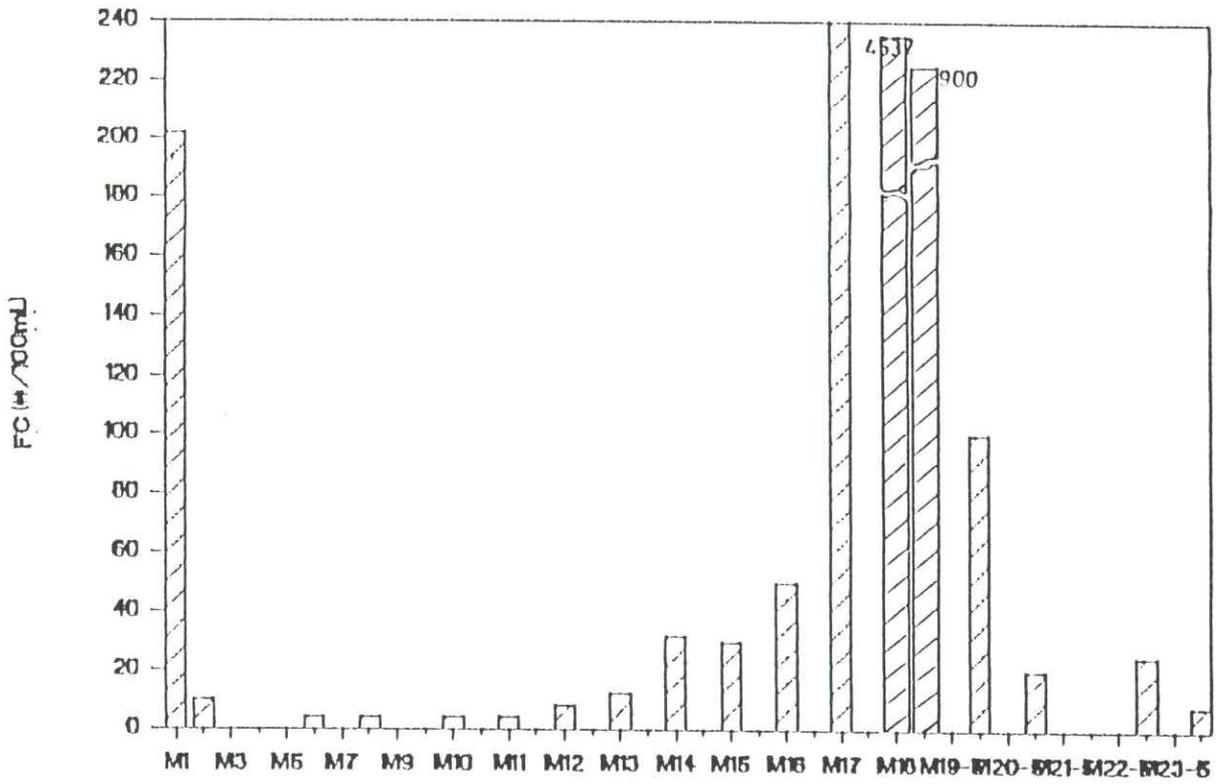
ŞEKİL 11.7.



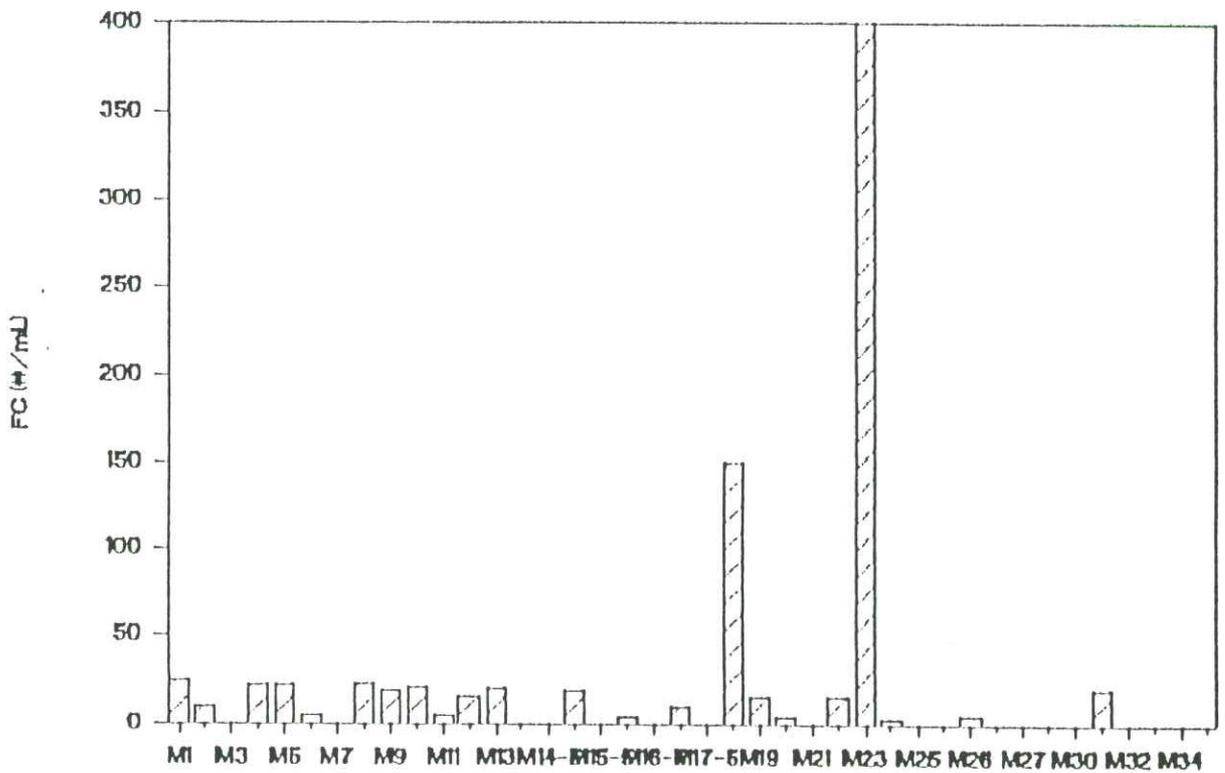
ŞEKİL II.7.



SEKIL II.8. Analik 1991-Ekim 1992 tarihleri arasinda Mersin korfesinde olculen koli basilinin mevsimlik degisimi

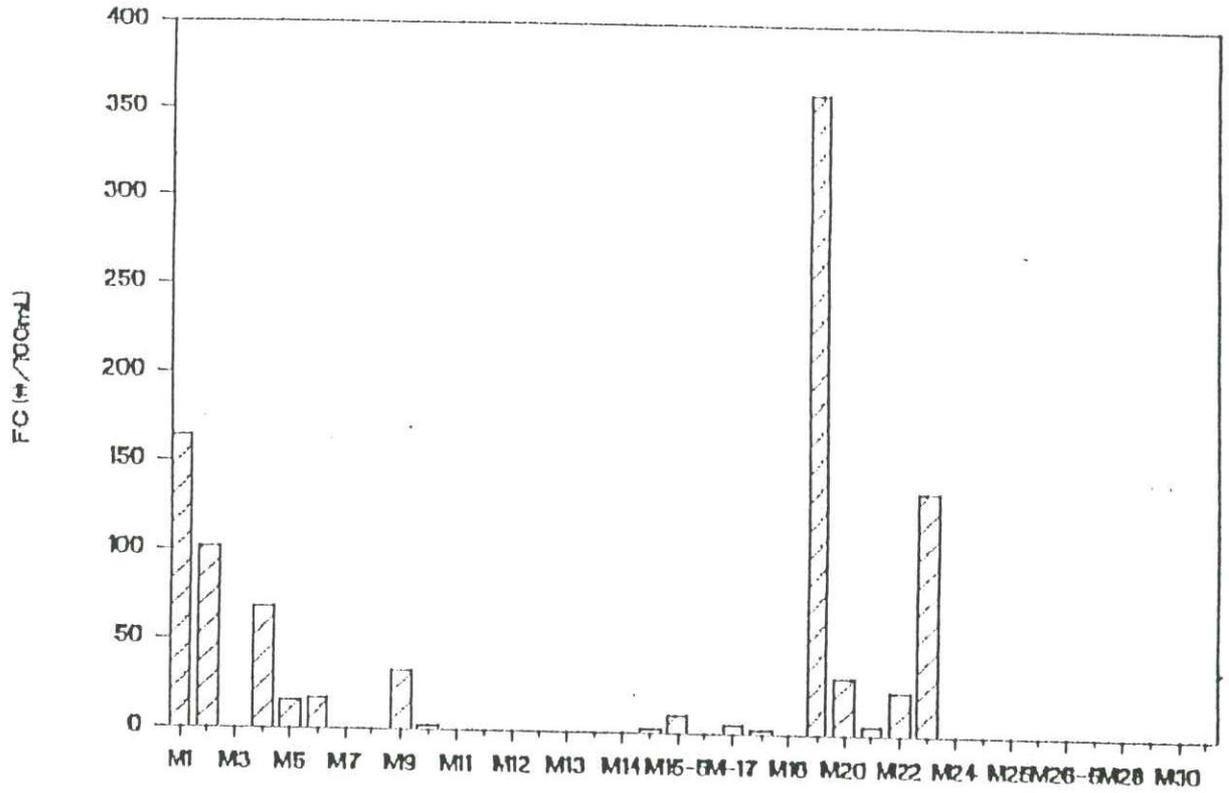


Örnekleme istasyonları Nisan 1992

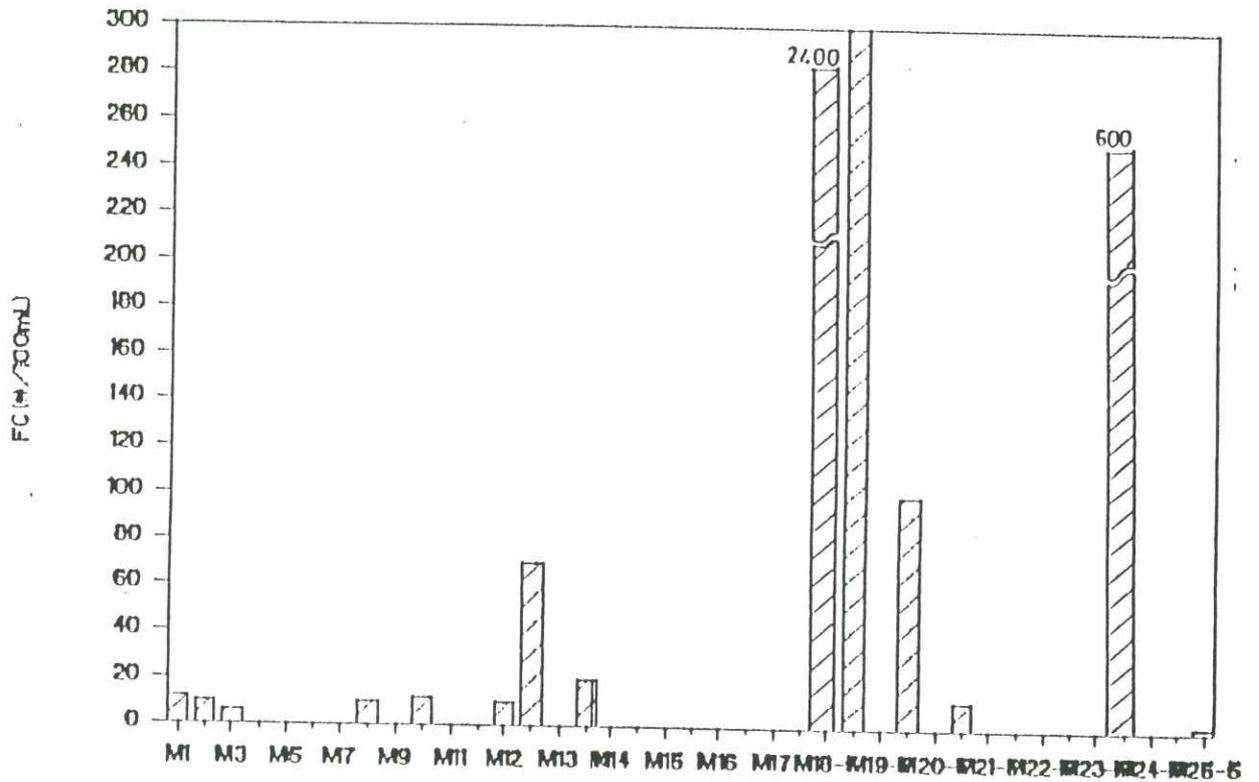


Örnekleme istasyonları Mayıs 1992

ŞEKİL II.8.

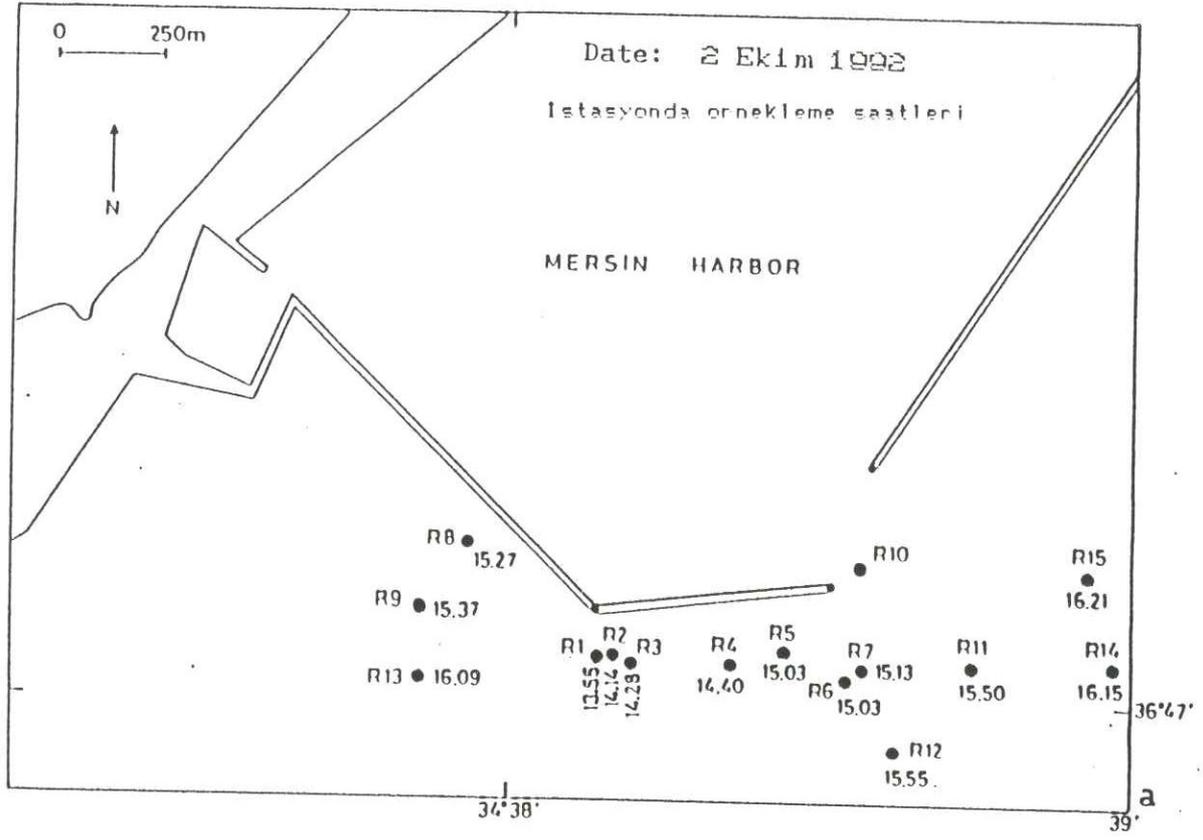


Örnekleme istasyonları Ağustos 1992

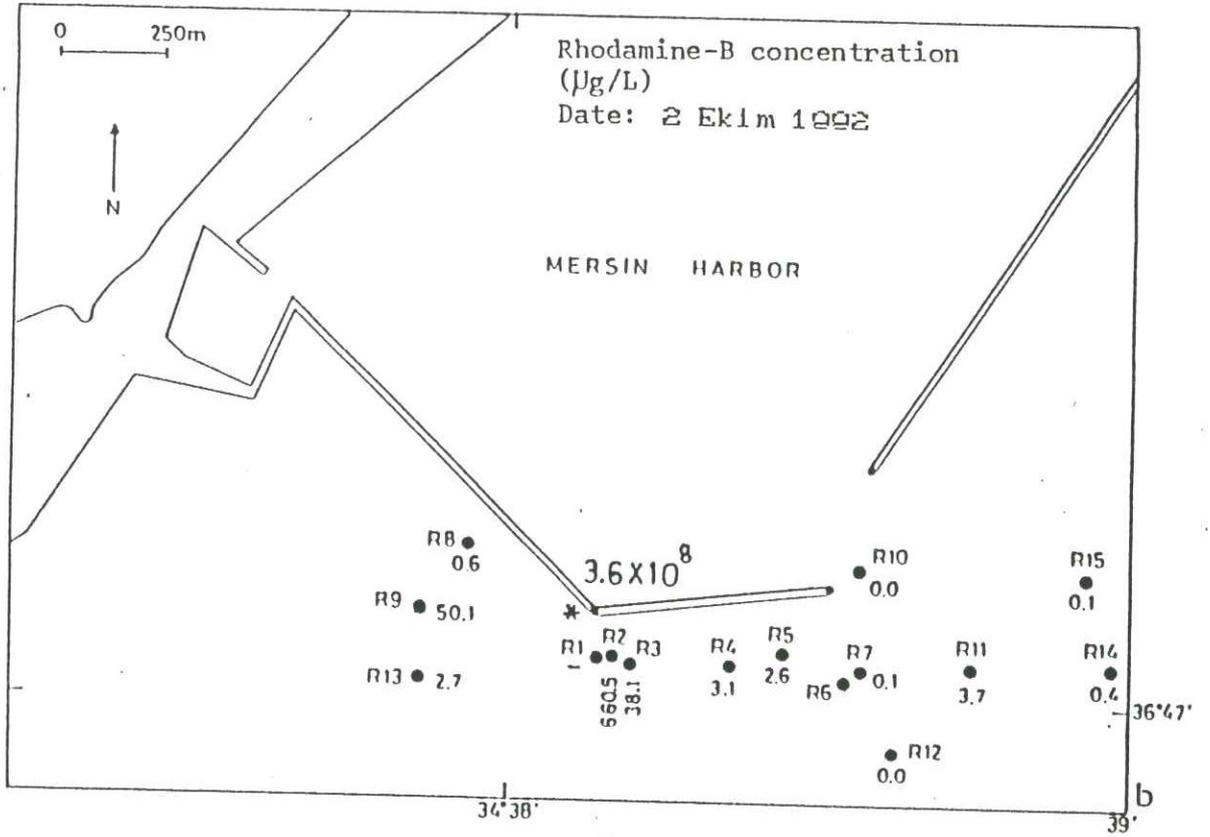


Örnekleme istasyonları Ekim 1992

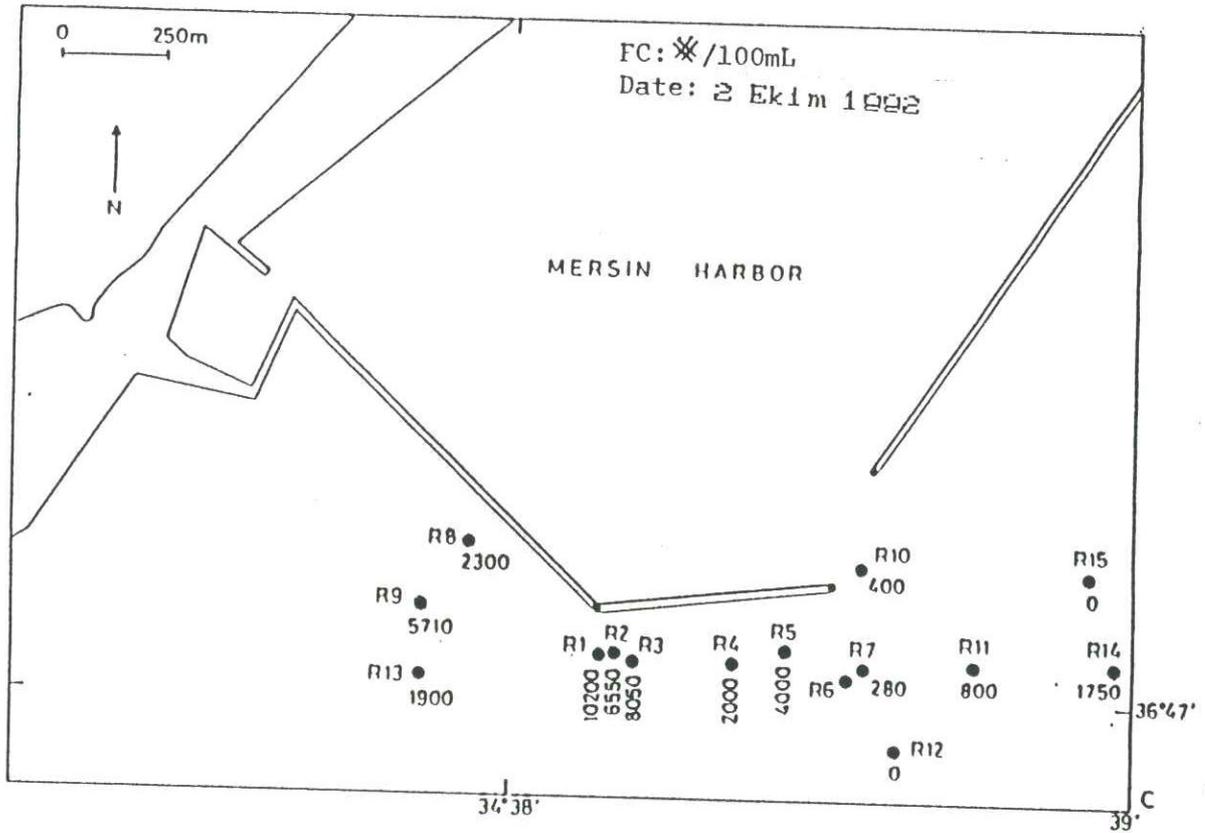
ŞEKİL II.8.



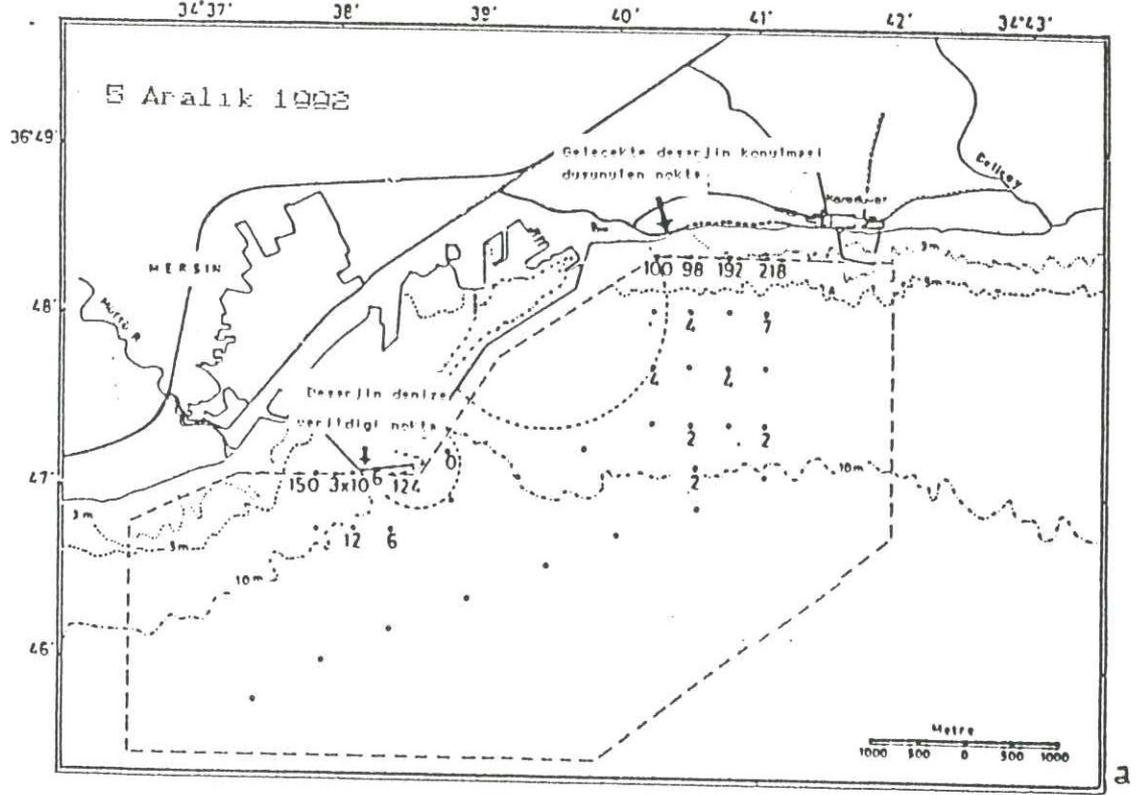
SEKIL II.9.a. 2 Ekim 1992 de Mersin Korfesinde yapilan Rhodomin-B deneyinde istasyonlardaki olcum zamanlari



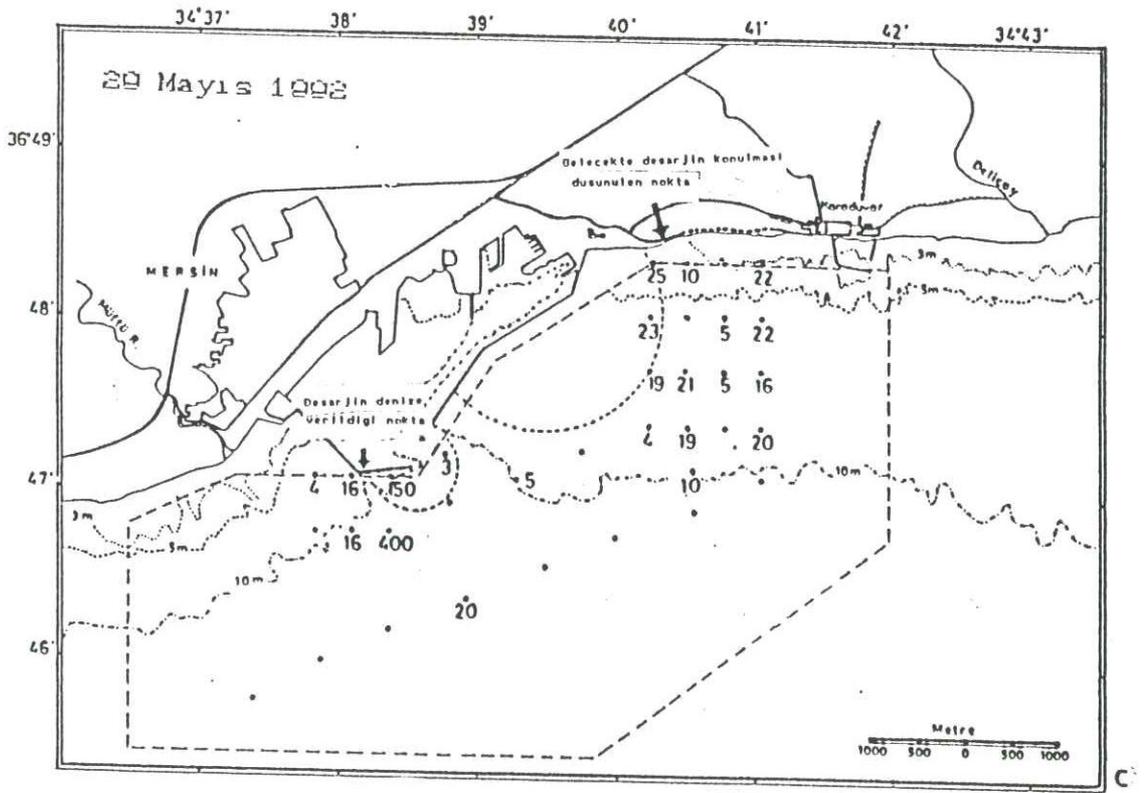
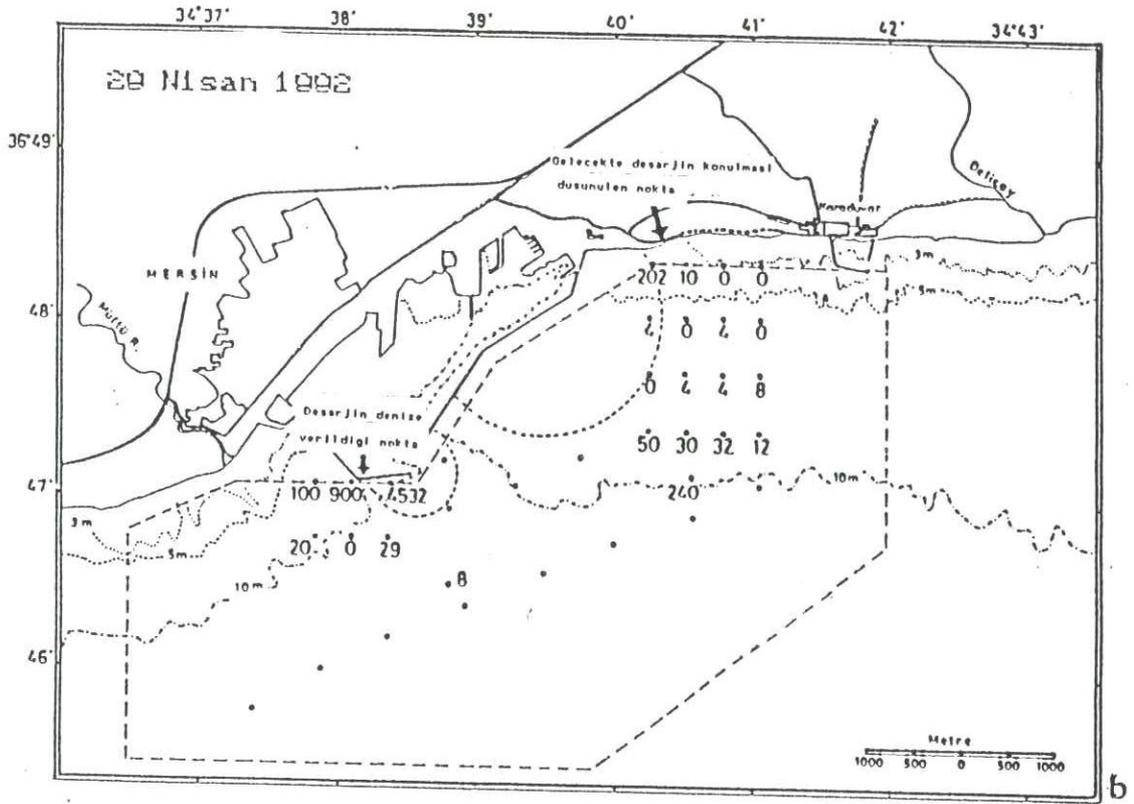
SEKIL II.9.b. Mersin Kanalizasyonunun denize verildiği nokta çevresinde ölçülen Rhodamin-B Konsantrasyonunun dağılımı



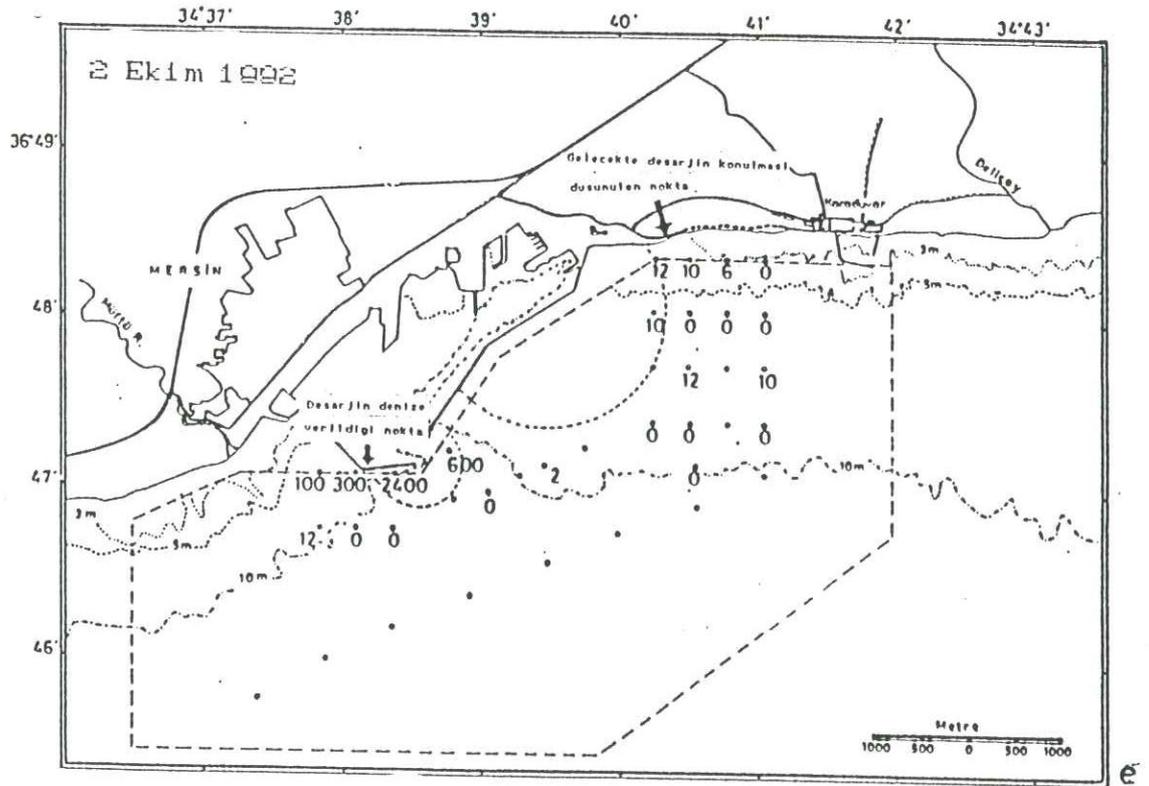
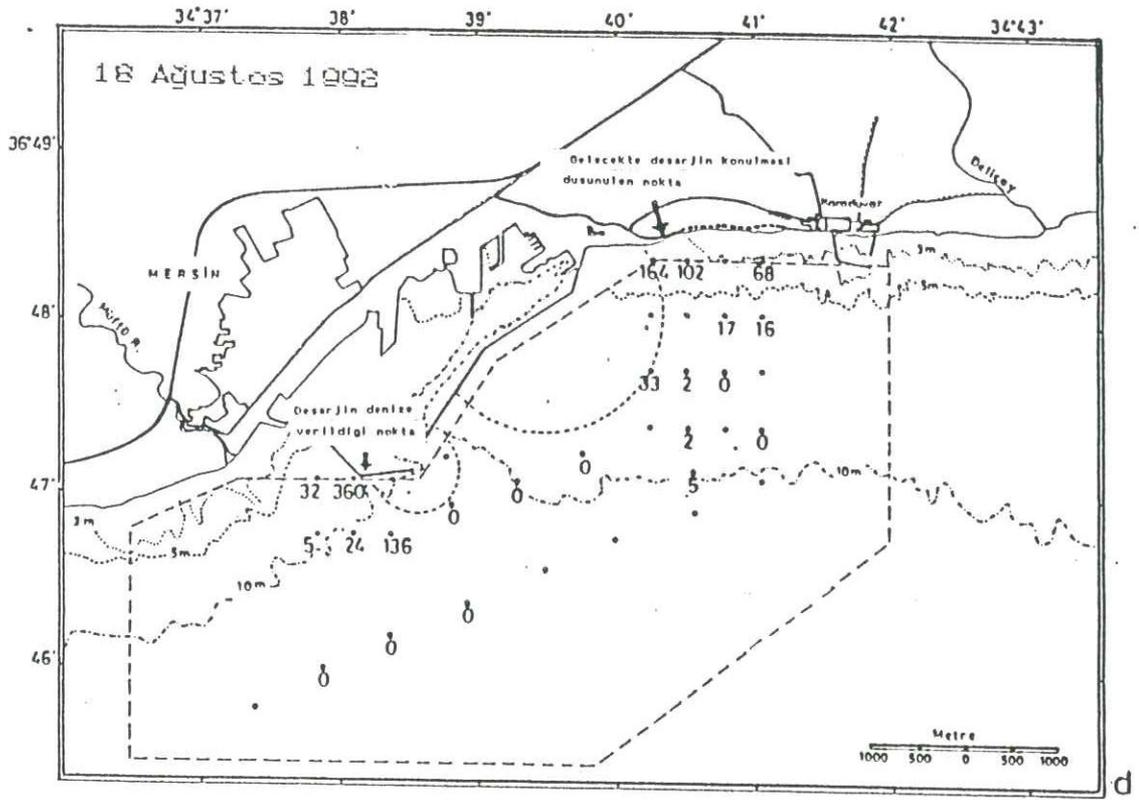
SEKIL II.9.c. Rhodamin-B deneyi sırasında Kanalizasyon akisi etrafından toplanan örneklerde sayılan kolu basılı miktarları



SEKIL II.10. 1991-1992 yılları arasında mersin kıyı sularında sayılan koli basilinin mevsimsel dağılımı



ŞEKİL II.10.



ŞEKİL II.10.

TABLO II.1. Mersin Kanalizasyonunda ve uc irmakta olculen kinleticiler ve biyokimyasal parametreler

Date:3-12-1991													
Sta. No.	pH	DO (mg/L)	BOD ₅ (mg/L)	COD (mg/L)	TSS (mg/L)	o-PO ₄ (µM)	NO ₃ +NO ₂ (µM)	Tot-P (µM)	PAH (µg/L)	Hg (ng/L)	Cd (ng/L)	Cd-TSS (ng/L)	FC (#/100mL)
Delicay	7.67	7.6	3.3	102.7	6.9	0.06	253.4	---	11.76	0.9	1.52	20.9	1080
Cavuslu	7.64	6.9	1.9	119.8	3.2	20.3	412.2	---	0.87	0.6	0.19	N.D.	508
Muftu D.	8.28	9.9	2.8	239.7	3.1	0.06	131.8	---	0.41	3.0	N.D.	N.D.	540
Mersin D.	7.63	9.4	339.0	753.3	198.0	1.37	---	---	354.68	2.0	0.2	N.D.	1372x10 ⁶
Date:27-2-1992													
Delicay	8.51	11.7	3.7	54.0	3.1	0.18	158.0	1.95	0.70	1.5	0.50	N.D.	150
Cavuslu	8.08	12.7	2.8	54.1	6.0	4.72	171.0	5.40	0.56	1.1	0.40	13.9	230
Muftu D.	8.96	9.5	2.3	103.0	1.2	0.61	75.4	0.83	1.07	1.4	0.10	N.D.	920
Mersin D.	7.39	8.7	175.0	398.7	63.0	63.20	153.3	166.00	253.14	2.5	1.31	138.4	800870
Date:11-5-1992													
Delicay	8.14	10.2	2.2	367.6	9.8	0.48	72.98	0.53	3.15	2.2	2.85	14.9	1877
Cavuslu	7.67	6.8	8.2	---	9.1	10.85	96.89	13.70	0.62	1.1	1.19	N.D.	1776
Muftu D.	8.48	10.1	1.6	176.0	24.3	0.86	34.70	1.50	0.08	1.5	0.91	9.9	308
Mersin D.	7.38	8.5	132.0	193.6	101.3	182.00	151.20	193.50	157.84	1.9	4.41	238.1	222x10 ⁵
Date:7-8-1992													
Sta. No.	pH	DO (mg/L)	BOD ₅ (mg/L)	COD (mg/L)	TSS (mg/L)	o-PO ₄ (µM)	NO ₃ +NO ₂ (µM)	Tot-P (µM)	PAH (µg/L)	Hg (ng/L)	Cd (ng/L)	Cd-TSS (ng/L)	FC (#/100mL)
Delicay	8.04	10.6	1.7	272.0	2.5	0.24	36.72	0.42	0.52	---	0.96	42.5	4250
Cavuslu	7.48	---	---	110.9	3.4	6.60	87.40	9.30	0.85	4.4	0.87	29.5	4000
Muftu D.	8.61	11.2	0.9	144.0	11.9	0.16	75.70	0.30	0.20	2.3	1.06	N.D.	1520
Mersin D.	7.36	7.9	18.5	320.0	125.0	124.8	5.60	128.0	21.91	4.1	1.49	398.2	4500000
Date:29-7-1992													
Delicay	7.76	8.8	1.9	63.3	3.0	1.20	132.30	1.50	0.45	2.0	0.92	47.4	1100
Cavuslu	7.42	4.8	1.4	39.6	2.8	3.00	146.40	4.00	0.14	3.3	0.53	208.9	580
Muftu D.	8.26	11.9	1.6	79.0	2.6	1.60	6.40	---	0.02	3.9	0.77	7.4	680
Mersin D.	6.89	8.1	---	87.0	44.0	12.80	8.80	44.00	84.79	3.2	2.40	1198.1	17000
Date:27-10-1992													
Delicay	8.18	8.1	3.9	32.2	1.0	0.55	43.50	0.70	1.96	---	1.16	818.4	1250
Cavuslu	7.50	6.1	2.3	16.1	3.9	2.00	45.60	2.25	0.06	3.4	1.22	265.4	750
Muftu D.	8.21	8.4	6.5	24.1	12.5	0.25	55.70	0.50	0.87	6.0	1.00	331.8	650
Mersin D.	7.22	8.8	266.3	273.3	70.7	42.00	8.60	52.00	13.86	8.4	2.03	3318.0	2700000

TABLO II.2. Analik 1991 de kiyi istasyonlarinda olculen hidrolojik ve biyokimyasal parametreler

Date:5-12-1991	Sta.No	Depth m	T °C	S (ppt)	pH	TSS (mg/L)	DQ (mg/L)	BOD ₅ (mg/L)	COD (mg/L)	o-PO ₄ (µM)	NO ₃ +NO ₂ -N (µM)	SD (m)	FC (#/100mL)
	M-1	0	15.88	38.2	8.08	10.9	7.03	0.55	1.60	0.45	23.32	---	100
	M-2	0	15.90	38.3	8.13	9.5	7.14	0.59	2.47	0.05	11.28	---	98
	M-3	0	15.88	38.2	8.13	10.1	7.14	0.51	2.25	0.23	9.10	---	192
	M-4	0	17.97	38.6	8.15	13.0	7.07	0.59	2.18	0.53	5.13	---	218
	M-5	0	17.43	38.6	8.20	19.1	7.25	0.39	2.11	0.02	1.19	---	7
	M-6	0	17.69	38.6	8.19	6.3	7.30	0.73	4.87	0.04	1.44	---	4
	M-7	0	17.80	38.7	8.20	22.9	7.30	0.49	1.81	0.03	0.96	---	4
	M-8	0	18.36	38.7	8.20	19.1	7.31	0.58	1.82	0.02	1.51	---	4
	M-9	0	18.31	38.6	8.20	11.9	7.27	0.51	1.50	0.03	0.80	---	4
	M-10	0	18.14	38.6	8.20	20.1	7.36	0.62	1.15	0.11	1.44	---	4
	M-11	0	18.16	38.5	8.20	5.7	7.32	0.56	1.45	0.02	0.45	---	4
	M-12	0	18.24	38.5	8.19	16.2	7.29	0.70	2.40	0.03	1.09	---	2
	M-13	0	18.35	38.6	8.18	16.1	7.32	0.57	1.67	0.03	0.96	---	2
	M-13	5	17.92	38.6	8.19	---	7.30	0.54	---	0.25	0.99	---	---
	M-14	0	18.42	38.6	8.18	15.3	7.31	0.63	2.25	0.05	0.99	---	---
	M-15	0	18.39	38.6	8.20	4.3	7.31	0.36	2.84	0.05	1.22	---	2
	M-15	0	18.48	38.6	8.20	4.1	7.33	0.58	2.62	0.29	0.93	---	2
	M-17	0	19.22	38.9	8.18	3.5	7.25	0.69	2.62	0.03	1.25	---	2
	M-17	5	18.92	38.9	---	---	7.28	0.80	---	0.03	1.15	---	---
	M-18	0	17.97	38.7	8.14	14.5	6.55	0.57	2.84	0.73	6.54	---	124
	M-19	0	18.14	38.7	8.14	8.1	6.58	2.83	5.01	1.10	5.42	---	3000000
	M-20	0	17.91	38.7	8.10	---	6.06	1.80	2.38	0.53	8.34	---	150
	M-21	0	18.66	38.8	8.20	---	7.30	0.50	---	0.02	0.93	---	---
	M-22	0	18.78	38.8	8.20	---	7.50	0.73	1.89	0.03	0.83	---	12
	M-22	5	18.25	38.7	8.15	---	7.48	0.80	---	0.03	3.65	---	---
	M-23	0	19.03	38.9	8.19	3.4	7.54	0.71	1.60	0.02	1.09	---	6
	M-24	0	---	---	8.18	19.5	7.12	0.47	---	---	---	---	0
	R-1	0	19.23	38.9	8.18	19.5	6.37	0.47	0.95	0.02	0.90	---	---

TABLO II.3. Nisan 1992 de Kiyi istasyonlarinda olculen hidrolojik ve biyokimyasal parametreler

Date:29-4-1992

Sta.No	Depth (m)	T °C	S (ppt)	pH	TSS (mg/L)	DO (mg/L)	BOD ₅ (mg/L)	COD (mg/L)	o-PO ₄ (µM)	NO ₃ +NO ₂ -N (µM)	SD (m)	FC (#/100mL)
M-1	0	18.80	---	8.25	5.1	10.21	3.85	4.1	0.55	1.68	2.5	202
M-2	0	19.85	---	8.25	18.9	9.64	4.26	5.5	0.30	0.66	2	10
M-3	0	19.80	---	8.28	16.2	9.63	3.12	3.9	0.07	2.13	2	0
M-4	0	19.60	---	8.33	15.4	9.51	4.33	6.5	0.25	2.74	2	0
M-5	0	19.85	---	8.29	13.5	9.08	3.52	4.8	0.09	5.03	2.5	0
M-6	0	19.85	---	8.24	11.2	8.36	2.13	5.1	0.16	0.61	2.2	4
M-7	0	19.85	---	8.24	3.3	9.20	2.07	4.0	0.16	0.39	2	0
M-8	0	19.90	---	8.27	13.4	8.37	2.78	3.2	0.19	0.69	2	4
M-9	0	19.90	---	8.23	16.2	8.37	1.95	3.5	0.02	0.18	2.5	0
M-10	5	19.85	---	8.11	---	---	---	---	0.16	0.20	---	---
M-10	0	22.00	---	8.21	15.5	8.66	2.22	2.9	0.09	1.27	3	4
M-11	5	19.90	---	8.10	---	---	---	---	0.08	0.41	---	---
M-11	0	22.00	---	8.22	5.4	8.93	2.14	3.7	0.02	0.15	2.5	4
M-12	5	19.90	---	8.13	---	---	---	---	0.22	0.25	---	---
M-12	0	20.05	---	8.21	7.8	8.46	2.76	4.4	0.07	0.41	2.5	8
M-13	5	19.90	---	8.17	---	---	---	---	0.29	0.25	---	---
M-13	0	20.00	---	8.16	16.9	5.53	1.42	1.5	0.25	0.30	3.5	12
M-14	5	19.90	---	8.10	---	---	---	---	0.02	0.25	---	---
M-14	0	19.95	---	8.20	12.0	8.46	1.10	4.4	0.02	0.15	3	32
M-15	5	19.90	---	8.15	---	---	---	---	---	---	---	---
M-15	0	21.00	---	8.08	10.9	8.53	1.50	1.5	0.02	0.15	3.5	30
M-16	5	19.90	---	8.10	---	---	---	---	0.02	0.66	---	---
M-16	0	22.00	---	8.14	5.1	8.68	1.32	23.9	0.02	0.30	3.5	50
M-17	5	19.90	---	8.15	---	---	---	---	0.02	0.15	---	---
M-17	0	19.95	---	---	4.1	8.56	1.16	21.4	0.02	0.86	3	240
M-18	5	19.90	---	---	---	---	---	---	0.02	0.38	---	---
M-18	0	20.00	---	8.13	13.2	8.63	3.51	19.1	12.20	16.80	2	4532
M-19	0	21.00	---	8.22	5.3	8.71	1.61	18.9	0.04	1.42	1.5	900
M-20	5	21.00	---	8.15	---	---	---	---	0.05	0.35	---	---
M-20	0	20.05	---	8.16	13.2	9.27	3.03	3.8	10.01	4.57	1.5	100
M-21	5	20.00	---	8.16	---	---	---	---	0.10	0.29	---	---
M-21	0	19.60	---	8.15	4.4	8.47	1.06	1.9	---	---	3	20
M-22	5	19.50	---	8.13	---	---	---	---	---	---	---	---
M-22	0	21.00	---	8.16	13.1	9.23	2.53	3.8	---	---	2.5	0
M-23	5	20.00	---	8.13	---	---	---	---	---	---	---	---
M-23	0	23.00	---	8.14	17.0	8.91	1.96	2.4	0.17	0.30	2.5	25
R-1	5	---	---	8.08	---	---	---	---	0.35	1.27	---	---
R-1	0	---	---	8.06	2.8	---	1.33	2.6	0.02	1.68	3.5	8

TABLO II.4. Mayıs 1992 de Kıyı İstasyonlarında ölçülen hidrolojik ve biyokimyasal parametreler

Sta.No	Depth m	Date:29-5-1992	T °C	S (ppt)	pH	TSS (mg/L)	DO (mg/L)	BOD ₅ (mg/L)	COD (mg/L)	o-PO ₄ (µM)	NO ₃ +NO ₂ -N (µM)	SD (m)	FC (#/100mL)
M-1	0				8.22	8.5	7.30	0.35	5.11	0.15	24.28	2	25
M-2	0				8.22	10.4	7.38	1.98	3.11	0.18	24.86	2	10
M-3	0				8.23	8.9	7.40	1.45	3.15	0.17	36.20	2	
M-4	0				8.21	8.0	7.48	1.68	2.20	0.20	35.80	2	22
M-5	0		23.87	34.4	8.23	8.4	7.52	1.90	2.80	0.25	29.20	2	22
M-6	0		23.80	34.5	8.20	5.6	7.46	1.85	2.80	0.18	27.16	2	5
M-7	0		24.02	33.9	8.25	5.0	7.86	2.06	3.04	0.16	24.17	2	
M-8	0		23.69	35.7	8.20	5.2	7.66	2.06	2.37	0.15	17.59	2	23
M-9	0		23.25	36.9	8.24	8.2	7.93	2.48	4.30	0.13	13.68	2	19
M-10	0		23.15	36.8	8.20	8.8	7.94	2.15		0.13	11.21	2	21
M-11	0		23.11	36.8	8.23	7.0	7.96	1.98	2.96	0.12	16.36	2	5
M-12	0		23.33	36.5	8.22	7.6	7.57	1.77		0.11	11.93	2	16
M-13	0		23.37	36.9	8.22	6.7	7.42	1.17		0.09	0.93	2	20
M-14	0				8.22	5.0	7.69	2.09	2.80	0.11	1.95	3	5
M-15	0				8.20		7.81	1.65		0.10	0.62		
M-16	0				8.25	24.4	7.50	1.17		0.11	1.75		19
M-17	0				8.19		7.63	1.79		0.08	7.51		
M-18	0		26.01	37.2	8.23	7.2	7.75	1.90	2.20	0.15	0.77	4	4
M-19	0				8.22		7.82	1.81		0.11	7.10		
M-20	0		23.00	37.3	8.21	4.7	7.87	2.12	3.10	0.10	7.92		10
M-21	0		22.37	37.6			7.40	1.17		0.08	0.99		
M-22	0		24.04	35.5	8.21	8.6			3.14	0.20	23.88	2	150
M-23	0		23.78	36.5	8.24	6.3	7.60	2.35		0.16	27.16	2	16
M-24	0		23.93	36.6	8.24	8.1	7.41	2.06		0.18	23.44	2	4
M-25	0		23.74	36.4									
M-26	0		23.30	36.6	8.25	16.4	7.94	2.65		0.17	23.88	2	16
M-27	0		23.70	35.1	8.25	15.4	7.12	1.88	2.71	0.29	25.92	2	400
M-28	0		23.92	35.9	8.25	9.5	7.78			0.24	30.84	3	3
M-29	0		23.49	37.1	8.25	7.6				0.21	24.28	3	
M-30	0		23.91	36.8	8.18	7.1	7.05	0.98	1.70	0.10	10.59	3	5
M-31	0		23.59	37.1	8.21					0.08	6.07	3	
M-32	0		23.86	36.9	8.22	4.8			0.80	0.05	0.07	3	
M-33	0				8.21					0.19	1.34	3	
M-34	0				8.20	2.6				0.11	6.17	3	
M-35	0		23.80	36.8	8.20	4.7	7.40			0.28	6.48	3	
M-36	0		26.69	36.8	8.21					0.09	0.31	4	20
M-37	0				8.22	7.6	7.30			0.11	32.08	3	
M-38	0		24.05	36.2	8.20	5.4	7.19		1.30	0.09	0.26	3	
M-39	0		23.89	36.7	8.22	11.1	7.61		2.50	0.10	0.51	3	
M-40	0									0.08	2.26	3	0

TABLO II.5. Ağustos 1992 de kiyi istasyonlarında ölçülen hidrolojik ve biyokimyasal parametreler

Sta.No	Depth m	Date:18-8-1992	T °C	S (ppt)	pH	TSS (mg/L)	DO (mg/L)	BOD ₅ (mg/L)	COD (mg/L)	o-PO ₄ (µM)	NO ₃ +NO ₂ -N (µM)	SD (m.)	FC (#/100mL)
M-1	0				8.08	13.6	10.74	1.55	3.41	3.16	0.44	2	164
M-2	0				8.10	9.5	9.04	1.88	4.13	0.54	0.65	2	102
M-3	0				8.09	17.3	9.32	3.17	7.02	0.29	0.60	2	
M-4	0				8.12	14.0	8.63	2.40	4.68	0.17	2.17	2	68
M-5	0		29.44	36.0	8.13	5.2	7.64	1.80	3.90	0.22	0.38	2	16
M-6	0		29.87	35.3	8.16	8.6	8.93	0.87	1.34	0.23	0.43	2	17
M-7	0		30.04	35.7	8.19	7.0	6.97	1.00	1.76	0.26	0.43	2.5	
M-8	0		29.53	35.5	8.22	7.0	7.98	1.50	3.71	0.29	0.87	2	
M-9	0		29.91	36.5	8.15	3.3	6.97	3.55	7.99	0.95	0.65	2	33
M-10	0		29.89	36.4	8.19	8.5	7.98	1.28	2.25	0.24	0.54	2	2
M-11	0		29.98	36.3	8.19	16.0	7.45	0.86	1.56	0.20	0.27	2	0
M-12	5		29.68	38.2	8.04					0.27	0.13		0
M-13	5		29.89	36.2	8.21	7.4	7.05	1.45	2.73	0.18	0.57	2	
M-14	0		29.62	38.3	8.03					0.18	0.33		
M-15	5		29.99	36.8	8.05	14.6	7.70	2.35	4.42	0.14	0.22	2	0
M-16	0		29.58	38.4					15.50	0.24	0.22		0
M-17	0		29.89	37.1	8.22	12.7	7.56	2.65	5.86	8.68	0.64	2	
M-18	5		29.84	37.3	8.22	7.3	7.28	2.58	5.00	0.22	18.21	2	2
M-19	0		29.65	37.4	8.19				5.09	0.21	0.33		10
M-20	0		29.86	37.3	8.23	18.8	6.89	1.95	5.63	0.03	0.54	2	
M-21	0		29.98	38.1	8.31		6.66	2.75		0.69	0.16		5
M-22	5		29.59	38.5	8.19					0.14	0.11		2
M-23	0		29.94	35.9	8.33	61.0	10.76	10.31	22.43	1.82	1.08	0.5	
M-24	0		30.66	35.8	8.31	33.3	10.85	2.96	4.69	1.94	6.63		360
M-25	0		30.47	36.6	8.28	120.0	11.90	5.81	13.02	4.56	11.96		32
M-26	0		30.28	37.0	8.32		9.49	4.20		0.44	1.32		5
M-27	0		30.24	36.6	8.36	16.0	10.56	3.10		6.06	1.10		24
M-28	0		30.52	36.5	8.30		11.35	3.36	8.23	1.60	0.33		136
M-29	0		30.07	36.0	8.36		10.26	3.12	6.64	4.48	0.88		
M-30	5		29.07	38.3						1.64	0.88		
M-31	0		29.67	38.0	8.26	26.0	8.22			6.06	0.44		
	0				8.23	32.5		2.50	4.30	6.48	8.68		
	5				8.07					0.27	0.33		
M-27	0		30.19	36.7	8.25	15.5			14.90	0.97	0.43		
M-28	0		29.74	38.0	8.22		7.62	2.90		1.25			
M-29	0		29.59	38.1	8.12		7.13	1.41		2.12		2.5	
M-30	0		29.60	38.0	8.14		6.82	1.94					
M-31	0		29.64	38.0	8.26		11.05	6.14				2.5	

TABLO II.6. Ekim 1992 de Kivi istasyonlarında ölçülen hidrolojik ve biyokimyasal parametreler

Date:2-10-1992	Sta.No	Depth m	T °C	S (ppt)	pH	TSS (mg/L)	DO (mg/L)	BOD ₅ (mg/L)	COD (mg/L)	o-PO ₄ (µM)	NO ₃ +NO ₂ -N (µM)	SD (m)	FC (#/100mL)
M-1	0	8.14	7.3	5.94	0.64	0.11	0.27	---	---	---	---	12	
M-2	0	8.14	12.2	6.29	1.07	1.72	27.11	1.69	1.69	1.72	27.11	10	
M-3	0	8.03	17.9	6.24	0.81	9.82	10.85	2.11	2.11	9.82	10.85	6	
M-4	0	8.00	19.9	6.32	0.80	20.32	10.52	2.17	2.17	20.32	10.52	0	
M-5	0	25.31	10.9	6.08	0.65	0.74	2.98	0.74	0.74	1.45	2.98	0	
M-6	0	25.82	10.3	5.64	0.35	0.52	0.54	0.52	0.52	1.26	0.54	0	
M-7	0	25.62	11.6	5.88	0.28	1.23	0.43	1.23	1.23	0.16	0.43	0	
M-8	0	25.93	19.8	5.89	0.36	1.51	0.43	1.51	1.51	0.15	0.43	10	
M-9	0	26.04	16.2	5.80	0.14	1.40	0.54	1.40	1.40	0.12	0.54	---	
M-10	0	26.00	21.9	6.15	0.18	1.58	13.12	1.58	1.58	0.16	13.12	12	
M-11	0	25.99	13.4	5.94	0.24	0.25	0.54	0.25	0.25	0.19	0.54	---	
M-12	5	25.82	19.5	---	---	---	0.54	---	---	0.07	0.54	---	
M-13	5	26.19	19.9	5.86	0.03	2.16	0.54	2.16	2.16	0.06	0.54	10	
M-14	5	25.71	26.4	8.15	---	---	0.54	---	---	0.09	0.54	70	
M-15	0	26.21	18.9	5.74	0.15	4.41	0.22	4.41	4.41	0.02	0.22	20	
M-16	5	25.97	19.8	---	---	---	0.22	---	---	0.03	0.22	---	
M-17	5	26.24	---	5.70	---	---	0.22	---	---	0.02	0.22	---	
M-18	5	26.03	---	---	---	---	0.33	---	---	0.02	0.33	---	
M-19	5	26.36	18.7	5.74	0.02	2.25	0.22	2.25	2.25	0.04	0.22	0	
M-20	5	26.07	---	5.63	---	---	0.22	---	---	0.02	0.22	---	
M-21	5	26.37	---	---	---	---	0.22	---	---	0.03	0.22	---	
M-22	5	26.09	---	8.14	---	---	0.33	---	---	0.05	0.33	---	
M-23	5	26.44	17.8	5.62	---	---	0.22	---	---	0.02	0.22	0	
M-24	5	25.94	5.9	5.60	0.55	2.40	1.52	2.40	2.40	0.20	1.52	2400	
M-25	5	25.63	21.9	5.93	0.05	---	1.08	---	---	0.30	1.08	---	
M-26	5	25.71	16.2	5.85	0.28	3.49	0.65	3.49	3.49	0.17	0.65	300	
M-27	5	25.56	48.5	5.75	0.10	---	1.52	---	---	0.37	1.52	---	
M-28	5	25.76	16.0	5.29	0.96	3.84	1.30	3.84	3.84	0.57	1.30	100	
M-29	5	25.66	---	---	---	---	---	---	---	---	---	---	
M-30	5	26.38	13.4	---	---	---	0.43	0.37	0.37	0.10	0.43	12	
M-31	5	26.09	---	8.04	---	---	0.33	---	---	0.07	0.33	---	
M-32	5	26.39	---	8.08	---	---	0.22	2.09	2.09	0.06	0.22	0	
M-33	5	26.09	---	8.08	---	---	0.22	---	---	0.03	0.22	---	
M-34	5	26.35	19.2	6.00	0.10	---	0.22	---	---	0.03	0.22	0	
M-35	5	26.02	---	5.77	0.11	---	0.42	---	---	0.03	0.42	---	
M-36	5	25.48	7.1	6.88	1.29	2.01	0.65	2.01	2.01	0.33	0.65	600	
M-37	5	25.71	---	5.35	0.51	---	1.08	---	---	0.29	1.08	---	
M-38	5	25.54	12.6	5.95	0.29	---	---	---	---	---	---	0	
M-39	5	26.16	13.3	5.66	0.05	---	---	---	---	---	---	2	

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c.3

OCEANOGRAPHIC STUDIES RELATED TO
THE MARINE SEWERAGE OUTFALL FOR MERSIN BAY

FINAL REPORT

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I.1 INTRODUCTION

The present Report provides an evaluation of the physical, chemical and bio-chemical oceanographic investigations conducted in the Bay of Mersin in relation to the proposed marine outfall project.

The scope of the studies included determination of the following:

- 1) physical and chemical characteristics of the water in the vicinity of the Mersin harbor;
- 2) prevailing currents;
- 3) climatological characteristics of the region, including wind waves.

The physical data are presented in Sec.I, and the chemical and bio-chemical data in Sec.II.

The water properties and the currents were determined in the field. The wind wave characteristics were determined using hindcasting techniques and waves measured near Mersin (at Erdemli) during 1978-79. The climatological characteristics of the region, which include the sea and air temperatures, winds, barometric pressure and relative humidity, were determined from meteorological data for Mersin.

I.2 CRUISE DATES, INSTRUMENTATION AND DATA PROCESSING

Data in the field were collected at the stations shown in Fig.I.1 on the following dates:

1. December 5, 1991. (physical and chemical parameters).
2. April 29, 1992. (chemical parameters).
3. May 29, 1992. (physical and chemical parameters)
4. August 18, 1992. (physical and chemical parameters)
5. October 2-3, 1992. (physical and chemical parameters)

Instrumentation.

Temperature and salinity were measured using a Sea Bird model 9 CTD profiling system. The probe measures the depth, temperature and conductivity simultaneously at a rate of 24 data points per second as

it is lowered into the water column. The temperature sensor has an accuracy of 0.01°C and the conductivity sensor of 0.001 Siemens. The probe can either transmit data to a deck unit on board, or the data can be stored in a memory unit and processed later. In this study the second option was used. After each cruise, the data for each station were bin averaged in 1 m bins.

The Decca trisponder system was used for positioning the boat and for obtaining the locations of the current meters.

The currents were measured using Aanderaa recording current meters. This is a self contained battery powered instrument that records data on magnetic tape automatically at preset sampling intervals. After recovery of the current meter, the data are read by a tape reading unit, and converted to engineering units.

I.3 TEMPERATURE, SALINITY AND DENSITY PROFILES

Temperature, salinity and density profiles for the four cruises are given in the following figures:

Dec 1991 cruise	Fig. I.2
May 1992 cruise	Fig. I.3
August 1992 cruise	Fig. I.4
October 1992 cruise	Fig. I.5

For each cruise, two sets of profiles are given. In the first set, profiles of temperature and salinity are plotted, while in the second set, profiles of temperature and the density parameter σ_t are given. The temperature is shown by the solid line and the salinity or density by the dashed line. At the very shallow stations only one value, at 1 m depth, is given.

The December data indicates vertically uniform distribution of salinity, and slightly lower temperatures near the bottom than at the surface. This is attributed to the vertical mixing of the relatively shallow water column due to winds and surface cooling. The density

profiles indicate a near homogenous structure in the upper 5-6 m of the water column, and an increase in density below that depth.

In the 29 May cruise, the surface salinities are lower and the surface temperatures are warmer than in December, indicating the effect of fresh water inflow during the spring season from the rivers and of radiational heating. The surface salinities are quite low, about 34 ppt, at the stations M-5, M-6 and M-7, which are located close to the shore on the east side of the harbor. At stations away from the shore, such as M-31 and M-32, the temperature indicates an increase of about 4°C from the bottom to the surface. At these stations, the salinity increases from about 37 ppt at the surface to 39 ppt at the bottom, which indicates that the fresh water input spreads out over the saltier water in the entire study area. The density profiles indicate the beginning of the development of a two-layer structure of the water column, consistent with the increased radiation in the spring and summer months.

In August, the surface temperature has increased to about 30°C . The upper 7 m of the water column has uniform temperature and salinity distribution. The density profiles also exhibit a two layer structure, with a density of 24 sigma-t units in the upper 7 m, and a gradual increase to about 25.8 sigma-t units towards the bottom.

In October, the distribution of salinity is vertically uniform, while the temperature is greater near the surface. This is due to the effect of mixing of the water column due to winds and subsequent warming of the surface after the end of the storm. The density profiles indicate a uniform vertical distribution.

Profiles of temperature, salinity and density at station M-32 are shown in Fig. I.6 for all four cruises to illustrate the changes through the year (station M-18 is used for the December cruise). Taking the beginning of the cycle in the fall season, it is seen that the water column in this shallow region near the coast maintains a

vertically well-mixed state from October through April. The strong winds of the winter storms and the cooler air temperatures both result in mixing the water column vertically, resulting in a uniform vertical structure. With the beginning of the warming season in spring, the surface waters become lighter and the water column begins to attain a two-layer structure. With continued heating through the summer, and due to the relatively weaker winds, the two-layer structure becomes well established during August and continues till the end of September.

I.4. CURRENT MEASUREMENTS

Current measurements, using moored current meters, were carried out during 22 April-12 May, 1992, and 22 July-13 August, 1992.

The deployment locations for April are shown in Fig.I.7, and for July in Fig.I.8. The current meter stations are identified by the serial number of the instrument at that station. The deployment depths are given below:

April 1992 (Fig.I.6):

RCM 4819	total depth: 5m,	current meter depth: 2.5m
RCM 2905	total depth 6m	current meter depth: 2.5m
RCM 6625	total depth 8.5m	current meter depth: 5.0m
RCM 6687	total depth 10m	current meter depth: 5.0m

July 1992 (Fig.I.7):

RCM 2905	total depth 11.5m	current meter depth: 6.0m
RCM 6625	total depth 11.5m	current meter depth: 6.0m

The sampling interval was set at 10 minutes for the April deployment and 20 minutes for the July deployment. In both cases, the data were averaged to obtain hourly values, and these values were used in subsequent plotting of the data. In evaluating the current data, reference is made to the wind velocity vectors, which are presented in Sec.I.5. The current data are given in three different forms:

1- current speed time series,

- 2- current velocity vector time series, and
- 3- progressive vector diagrams.

April-May currents.

Figs. I.9-I.10 show the time series of the current speed for the measurement period between 22 April - 12 May for the four stations. The average speeds are given below:

RCM 6625	14.9 cm/s
RCM 6687	21.6 cm/s
RCM 4819	23.5 cm/s
RCM 2905	28.8 cm/s.

The time series of temperature and salinity at the current meter station CM 6687 are shown in Fig. I.11.

The current velocity vectors time series are shown in Figs. I.12-I.15. In these figures, the hourly average current velocity is plotted as an arrow, the length indicates the speed (1 cm = 20 cm/sec) and the direction of the arrow is the direction towards which the current is flowing, using the usual convention for direction: north towards the top, east to the right of the figure.

A comparison of the currents, for this deployment period, with the wind (cf:Sec.I.5) shows that the currents on the west side of the harbor are in good agreement with the wind, while the currents on the east side exhibit considerable variability in direction.

On the west side of the harbor, at CM 6625 (Fig.I.12) and CM 6687 (Fig.I.13), the current velocity vectors are seen to possess a predominant component towards northeast. The wind velocity vector time series for April and May 1992 (cf:Sec.I.5) shows that during the period 22 April - 3 May the winds were alternately from the southwest and the northeast sectors, but the stronger winds were from the southwest (towards the northeast). The current direction during this period (Figs.I.12-I.13) is also predominantly towards the northeast

indicating that the currents in this region are in good agreement with the wind. Between 4-7 May the wind record indicates winds from varying directions, probably related to the passage of a weak cyclonic system. In this period, (day 12-15, Figs. I.12, I.13) the currents on the west side of the harbor the current displays changes in direction and speed, consistent with the changing winds.

On the east side of the harbor, at CM 4819 (Fig. I.14) and CM 2905 (Fig. I.15), the current does not indicate a predominant flow direction. In the first five days of the measurements the current flows mainly towards the west, which is opposite to the direction observed on the west side of the harbor and also against the wind direction during this period. The direction of the current after the fifth day till the end of the data exhibits considerable variability, with no apparent relation to the wind. To investigate the flow patterns in the region as a whole, the current velocity for each current meter is plotted in the form of progressive vector diagrams. These diagrams are obtained by plotting the hourly average velocity vectors consecutively. At CM 6625 (Fig. I.16) the flow direction is towards the east-northeast for the first 13 days and then becomes variable. At CM 6687 (Fig. I.17), which is further offshore, the current is towards the northeast, with only small variations. These directions are in good agreement with the wind direction, and indicate that the currents are due to the winds from the south and south west and are not significantly influenced by the relatively weak winds from the north which occur cyclically between the southerly winds. On the east side, at CM 4819 (Fig. I.18) the current is towards the west for the first six days of the data and then undergoes several reversals in direction as indicated by the loops after the sixth day. At CM 2905 which is offshore of CM 4819, the flow initially has a westerly direction, and changes to northeast after the sixth day (Fig. I.19). Several reversals are also observed, as indicated by the loops.

The current patterns discussed above indicate the existence of an anticlockwise eddy located on the eastern side of the harbor,

resulting in a reverse flow as compared to the flow offshore of the harbor. Both current meter stations on the east side of the harbor were apparently influenced by the eddy circulation and exhibited different flow patterns than the stations on the west side of the harbor. Stations for current measurements during the summer were therefore placed slightly further offshore in order to determine the currents outside the eddy.

July-August currents.

Current measurements at the stations shown in Fig. I.7 were carried out during the period 22 July - 13 August. The stations were deeper by about 2 m than the April deployment. When the current meters were taken out it was seen that the instruments were covered by marine growth which had almost stopped the movement of the rotor in the last part of the measurement period. The time series of the speeds are shown in Fig. I.20. It is seen that the speeds begin to progressively decrease after about 12 days, due to the effect of the marine growth. The average speeds, using only the first 12 day data are:

RCM 6625	22.6 cm/s
RCM 2905	24.0 cm/s.

The wind data for July and August (cf: Sec. I.5) show the pattern of the sea-breeze typical of the region during the summer. The wind is from the southwest during the afternoon, and from northeast during night time. The current velocity vector time series are shown in Figs. I.21 and I.22, and the progressive velocity vector diagrams in Figs. I.23-I.24. The time series of temperature and salinity for CM 6625 are given in Fig. I.25. It is seen that the currents at both stations are similar, indicating that the locations were subject to the same flow and outside the influence of the eddy. The current also fluctuates with the changes in the wind, however, the dominant flow direction is towards the northeast. This is consistent with the wind data, which shows that the sea breeze is stronger than the land

breeze.

The current data may be summarized as follows. The currents are essentially driven by the wind in this nearshore and shallow region of the coast. The dominant current direction offshore of the harbor was easterly in both measurements, however, several reversals were also observed. A small scale anticlockwise eddy exists on the east side of the harbor near the shore, probably generated by the shear of the easterly current on the water mass between the east breakwater and the shore. The eddy was not observed in the July-August measurement set, when the current meter station on the east side of the harbor was located further offshore, indicating the eddy is limited in extent to approximately the location of the current meter stations in the July measurement. The current speeds were approximately 20 - 25 cm/s, except at CM 6625 in the April deployment, when the average speed was 15 cm/s.

1.5 CLIMATOLOGICAL CHARACTERISTICS

Winds.

The wind regime in the region is dominated by the passage of cyclonic systems from approximately October until April and a sea breeze - land breeze pattern during the rest of the year. During the winter, the wind direction and speed are dependent on the track of the cyclonic system over the region, while in the summer the sea breeze (southwesterly) is the dominant wind. The region is also subject to occasional outbreaks of a strong wind from the northeast, known locally as Porayz. The hourly average wind velocity vectors for the year 1992 (January-October) are given in Fig. I.26, and illustrate the features discussed above. During January of this year the winds were generally weak, which is not generally the case. Storms with strong southwest winds are observed from about the middle of February till May. The summer wind regime begins to appear in June, and continues through October.

The wind gust data for 1992 is given in Table I.1. During the winter, the dominant directions of the strong winds are northeast and southwest, while in the summer the strong winds are from the southwest. In May, three observations of wind exceeding 10 m/s from the northeast and east-northeast are seen. The per cent frequency of wind directions on a monthly basis for 1992 is given in Fig. I.27. Calm conditions are assumed for wind speed (V) less than 1 m/s. This number is shown for each month on the figure.

The longer term characteristics of the wind are illustrated by the wind velocity vectors for the period 1977-1991, plotted in Figs. I.28-I.42. In these figures, observations taken three times during the day (07:00, 14:00 and 21:00 hrs) have been used. In addition to the general winter and summer wind patterns discussed above, significant differences are seen on an interannual basis. The percent frequency of wind direction for each year is given in Fig. I.43. It is seen from this figure that on an annual basis, winds from the NE-NW and from the SW are dominant. The wind frequency on a monthly basis is given in Fig. I.44. Winds from the NE-NW sector are dominant during winter (November-March), while southwesterly winds dominate during the summer months. It is worth noting that while the relative frequency of winds from the southwest during the winter is low, strong winds are observed from the SW-SE sector during winter, as seen in the wind gust data given in Table I.1. These winds are seen more clearly on synoptic maps. A publication of the Turkish Navy (1984) gives the following dates and wind directions for storms, defined as wind speed greater than 16 m/sec :

3	March	1953	N
27	January	1959	SW
13	January	1968	SW.

Barometric pressure.

Typical records of the barometric pressure for four years between 1981 and 1990 are shown in Fig. I.45. In this figure, the pressure is plotted after subtracting the mean in order to emphasize the

fluctuations. The highest fluctuations occur during the winter months, associated with the passage of cyclonic systems of duration 3-5 days. However, occasionally a high pressure system settles over the region for longer periods, as in February-March 1985 and in mid-January, 1987, resulting in clear and generally calm conditions. The barometric pressure for 1992 is plotted on a monthly basis in Fig.I.46. Comparison with the wind data shows that the stronger winds (such as on 19 February, 10-12 and 18 March, 12-13 and 20 April) occur when the pressure fluctuations occur within an interval of 2-3 days. A decreasing trend in the pressure is accompanied by winds from the southwest as the cyclonic system approaches, and an increasing trend in the pressure is accompanied by northerly winds as the system travels towards east away from the region.

Wind waves.

The coast of Mersin is open to wave action from the SW-SE sector. The wave height in deep water depends upon the strength and duration of the wind, and the fetch length (the distance over which the wind is effective in generating waves). Near the shore, the wave height is modified due to shoaling, breaking and refraction. In the case of Mersin, the longest fetch exists when the storm system is located in the eastern Mediterranean in the region of Crete. However, the coast of Mersin is partially sheltered from waves from the southwest and south by the island of Cyprus. The track of cyclonic systems over the Mediterranean is from west to east, resulting in strong winds from the southeast if the center of the storm passes over Cyprus. In this case the fetch is about 150 nautical miles, however the waves can approach the coast without any obstruction. Thus, while waves from the SW are more frequent, the coast is open to severe wave action from southeast also. The wave characteristics for the study region in the present study have been determined by utilising synoptic maps between 1977 and 1990 to determine the winds over the sea during storms, the fetch length and the duration of the storms. The deep water wave characteristics were compared with measured wave data to obtain an empirical reduction factor for the wave height. The method used for

predicting the deep water wave characteristics is given in the Shore Protection Manual (1973). This approach, and other similar empirical approaches are subjective and open to errors. For example, defining the fetch is a matter of judgement of the operator, and the effect of the existing waves present in the region before the storm is difficult to account for accurately.

The measured wave data were from measurements made by the Institute of Marine Sciences during 1978-1979 at Erdemli, which is 35 km west of Mersin. The measurements were obtained using a Datawell wave rider bouy. The bouy was anchored in 30 m depth. Waves of 2 - 3 m height were recorded frequently during the period November 1978- April 1979. The maximum recorded wave was 4 m high, in March, 1979. Some examples of the storms and the wave records are given in the following. The synoptic maps are given in Fig.I.47 and the measured wave records in Fig.I.48.

Fig.I.47(a) shows the synoptic map for 15 December, 1978. The storm centre is located over the Black Sea. The empircally calculated wave height for this case is 4.5 m. The measured wave record is given in Fig.I-48(a). The average wave height is about 1 m and the maximum wave height is 2.5 m. The ratio between the two ($2.5/4.5$) is 0.55. Fig.I.47(b) shows the situation for 3 January 1979. In this case the low is located in the Aegean sea. The predicted wave height is 5.8 m. The measured wave record is shown in Fig.I.48(b). The average wave height is about 1.8 m, and the maximum wave height is 2.8 m, giving a ratio of $2.8/5.8$ or 0.48. The third case shown is for a system with its centre located southwest of Cyprus, Fig.I.47(c), for 7 March, 1979. In this case the predicted wave height is 6 m. The measured wave record, Fig.I.48(c) shows the average wave height was about 2.4 m, and the maximum wave height was 4 m. The ratio of the maximum measured wave height to the predicted height is $4/6$, or 0.67.

In order to determine the probable maximum wave height that can be expected to occur at the study region, a search of the synoptic maps showed that the storm system shown in Fig.I.47(d) for 18 January 1985

is typical of the severe storms that pass through the region. The wind speed in such a system (computed from the spacing between the isobars) is about 55 knots. With a fetch of 150 nautical miles, the predicted significant wave height is 9 m. Using an average ratio of 0.55, the maximum wave height near the coast would be about 5 m, and the average wave height about 3 m. As for the period, the measured wave period for the 7 March 1979 storm was 4.5 sec, while the predicted period was 10 sec. The predicted period for the 18 January 1985 storm is 12 sec., thus the wave period at the site can be expected to be about 6 sec. These estimates of the height and period are believed to be reasonable in view of the measured data at Erdemli. However, it should be noted that this is not the absolute maximum wave height that may occur under extreme conditions, such as in a 1 in 100 year storm, but is a wave height that can be expected to occur once every 10 to 15 years.

Air and sea surface temperatures.

The annual variation of air temperature for the years 1981-1991 is given in Fig. I.49. In general, the lowest temperatures are about 9°C and occur in February-March, while the highest temperatures are between 28°C-30°C, and are observed during July and August. There is, however significant interannual variability, particularly in the value and the time of occurrence of the lower temperatures. The air temperature fell to about 2°C in January, 1983, and in February, 1985. In 1984, relatively high air temperatures, about 12°C were observed during January-March, and the lowest air temperature occurred in December. In 1987, the temperature averaged about 12°C in January and February, but decreased to about 8°C in March, and remained below the average temperature till the beginning of the summer season.

The sea surface temperatures for the years 1985-1990 are shown in Fig. I.50. The lowest temperatures range between 13°C-15°C and occur in February-March, while the highest temperatures of 28°C-29°C are observed in July and August. As in the air temperatures, considerable interannual variability exists in the sea surface temperatures. In

1985, the temperature falls to about 11°C in March, about 3°C below the average. In 1987, consistent with the air temperature for this year, the sea surface temperature dropped by about 2°C in March relative to its value in January-February, and similar to the air temperature for this year, remained below the average value till the beginning of the summer.

Relative humidity.

The relative humidity for the years 1941-1990 is shown in Fig. I.51. In this figure, the average relative humidity for each month is plotted. These values are listed in Table. I.2.

I.6 SUMMARY OF PHYSICAL AND CLIMATOLOGICAL DATA

The water temperature, salinity, and density stratification of the study area, due to its proximity to the coast and shallow depth, are effected by local inputs of fresh water, and the intensity of vertical mixing caused by winds and surface cooling. The water column is well-mixed during October through April. Stratification begins in May, and becomes well established in August-September. The thickness of the surface mixed layer is about 8 m at that time. The temperature of the mixed layer is about 29°C - 30°C in August.

The currents in the study region are essentially governed by the prevailing winds. During the winter, the wind is predominantly from the NE-NW sector. There are, however, strong winds from the SW-SE sector also, associated with the passage of cyclonic systems. During summer, a sea-breeze land-breeze system prevails, with the stronger winds coming from the southwest. Thus, the predominant current direction is towards the northeast during the summer. During the winter, the currents will be of variable directions, depending on the winds. The easterly current generates an anticyclonic eddy on the east side of the harbor close to the shore. The offshore extent of the eddy is approximately the same as the offshore extent of the harbor structure.

The region is open to wave action from the SW-SE sector. Waves of 4 m height have been measured at a site near the study area (at Erdemli). The maximum wave at the site, based on hindcasting using synoptic charts for the past 15 years, is estimated as 5 m.

II. BIOCHEMICAL CHARACTERISTICS AND POLLUTION STATUS OF MERSIN BAY

II.1. POLLUTION FROM LAND-BASED SOURCES

Periodic analysis of the effluents from the existing outfall system of Mersin was carried out; selected biochemical and pollution parameters were measured in the wastewaters given to the sea. Similar measurements were also conducted in the three creeks flowing into the Bay, namely Delicay, Muftu, and Cavusoglu (canal) on a bimonthly basis. Abbreviations, symbols and the units used in the presentation of the results are given in Appendix A. Appendix B covers the brief descriptions of the analytical methods followed during the measurements of biochemical and pollution parameters in the present work. The concentrations of the biochemical and pollutional parameters determined in the wastewaters and the creeks are given in Table II.1.

pH

The pH in the fresh waters of the creeks was recorded to range between 7.42 and 8.96; the minimum and maximum values were measured in the autumn months and the early spring, respectively. Since the river waters are mixed with sea water the final pH of the polluted river waters is expected to be buffered by sea water with a pH level of about 8.2. The pH of the Mersin effluents discharged directly into the receiving seawater was relatively low, with an average value of 7.63; the minimum level was determined to be 6.89. The pH values determined in the wastewaters from the Mersin outfall system in December 1991 and October 1992 are within the limits set for domestic effluents (Regulations on Water Quality Control, 4/September/1988, No. 19919, Resmi Gazete).

Dissolved Oxygen (DO):

The concentrations of dissolved oxygen measured in three creeks were in the range of 7.5-10.2 mg/L. The highest values were recorded in

February 1992, because of the increase in the solubility of oxygen in cool winter months as well as a decrease in its consumption during unfavourable winter conditions. The Dissolved Oxygen content of Mersin effluent was 8.5 mg/L on average, which was quite high for a waste water. Unexpectedly high DO measured in the effluents may have resulted from the aeration of wastewaters since it is open to atmosphere.

Biochemical Oxygen Demand (BOD₅):

As is well known, the Biochemical Oxygen Demand (BOD₅) is a measure of the amount of oxygen required by bacteria and other microorganisms to oxidize the biodegradable organic matter in water; thus the larger BOD₅ levels in water represent the amount of biodegradable organic matter of man-made origin entering the fresh waters. The BOD₅ was observed to range from 2.6 to 3.3 mg/L in the creek waters. The total BOD₅ loads from Delicay, Cavuslu and Muftu creeks were 2.6×10^2 , 0.3×10^2 and 1.9×10^2 tons/year, respectively. These loads are much lower than the inputs from the major rivers to the coastal waters of the Northeastern Mediterranean. The total organic loads of the major rivers in the area have been estimated to be 39.9×10^3 tons/year for the Ceyhan, 44.9×10^3 tons/year for the Seyhan and 6.3×10^3 tons/year for the Goksu rivers (Yilmaz et al., 1992a). The average BOD₅ concentration was determined as 186.2 mg/L for the existing Mersin discharge (Central discharge) and the maximum value was as high as 339 mg/L. It may be estimated that the existing sewerage system introduces a BOD₅ load of 3.5×10^3 tons/year to the Bay. The theoretical domestic BOD load produced by the present population in the Mersin area, assuming a BOD load of 25-70 g/capita/day (UNEP, 1989) and an average population of 500.000 is approximately 4.5×10^3 tons/year, very similar to the estimate from our measurements. The average BOD₅ concentration for the Mersin effluent is close to the upper limit imposed for domestic effluents by the "Regulations for Water Quality Control" (4/September/1988, No. 19919, Resmi Gazete).

Chemical Oxygen Demand (COD):

Organic matter from various origins may be resistant to biochemical oxidation by microorganisms under the natural conditions of the receiving water environments but can be oxidized chemically at elevated temperature under strong acidic conditions. Therefore, the measurement of the quantity of chemically oxidizable organic matter in waters, the so-called Chemical Oxygen Demand (COD), gives us valuable information on the total organic content of water as well as the percentage that is biochemically degradable in the marine environment over a period of several days. The COD concentrations of the three creek waters were observed to vary between 68.1 and 148.9 mg/L ; the total COD loads calculated for Delicay, Cavuslu and Muftu creeks were 13.9×10^3 , 0.7×10^3 and 9.2×10^3 tons/year, respectively. The COD concentrations (thus loads) were expected to be twice the BOD_5 concentrations (and loads), but the high COD/ BOD_5 ratios in the creek waters discharged into Mersin Bay indicate large quantities of industrial wastewaters to have been given to the rivers. The average COD content of Mersin effluent was approximately twice its BOD content, approaching the general ratio observed in domestic wastewaters. The total COD load was calculated as 6.4×10^3 tons/year for the central Mersin effluent.

Total Suspended Solid (TSS):

The concentration of total suspended solids (TSS) was observed to range from 4.4 to 9.2 mg/L in the water samples from the creeks; the largest values were measured in May 1992 when the flows of the creeks were relatively high. The total loads were 4.1×10^2 , 0.5×10^2 , and 6.6×10^2 tons/year for Delicay, Cavuslu and Muftu creeks respectively. The average concentration was calculated to be about 100 mg/L for the central Mersin effluent, corresponding to an input of 1.9×10^3 tons of TSS per year to the shallow waters of the Bay.

Nutrients:

Nutrient inputs from land-based sources to the Mersin Bay were

calculated for the three creeks and existing Mersin central effluent using the average concentrations determined in the effluents and their daily flows. The total inorganic phosphate loads of Delicay, Cavuslu and Muftu creeks were 1.32, 2.50 and 1.33 tons-P/year, respectively. The corresponding total phosphorus loads of the creeks were 2.87, 2.50 and 1.76 tons/year, indicating that a remarkable fraction of the total phosphorus is introduced as dissolved inorganic phosphate. The inorganic phosphate and total phosphorus discharges from the Mersin sewerage system were 41.9 and 66.5 tons/year respectively, much larger than the total of inputs from the creeks. On the other hand, total oxidized nitrogen inputs from the creeks were estimated to be as high as 153.6, 22.7 and 64.4 tons/year for Delicay, Cavuslu and Muftu, respectively, whereas the input from the Mersin outfall system was approximately only 1.2 tons/year. This high quantity of nitrogenous material could be attributable to the usage of artificial fertilizers in farming areas.

Polyaromatic Petroleum Hydrocarbons (PAH):

Coastal refineries, industrial and municipal wastes are the major land-based sources of petroleum pollution in the coastal marine environment. The three creeks and the Mersin effluent were monitored periodically for the estimation of the dissolved/dispersed polyaromatic petroleum hydrocarbon input from these sources to the Mersin Bay. The average concentrations of PAHs were 0.52 and 0.36 $\mu\text{g/L}$ for the Cavuslu and Muftu creeks. The concentration of PAH was as high as 3.1 $\mu\text{g/L}$ in the fresh waters of Delicay creek, probably originating from the petroleum related industries located in the Delicay region. The total inputs from these creeks were in the range of 5.3-290 kg/year. The concentration was as high as 148 $\mu\text{g/L}$ in the Mersin effluent; thus, 2.8 tons of petroleum hydrocarbon of domestic origin are being discharged annually to the Bay via this source..

Heavy Metals; Mercury and Cadmium (Hg and Cd):

Mercury, one of the toxic metals for marine ecosystems, was measured

periodically in the water samples taken from the creeks and the Mersin domestic effluent. The concentration ranged from 0.6 to 6.0 ng/L in the creek waters and it was 1.9-8.4 ng/L for the Mersin effluent. The total mercury loads were estimated as 159.5, 25.2 and 216.6 g/year for Delicay, Cavuslu and Muftu creeks, respectively. The input from the sewerage outfall system was about 70 g/year, within the range of the creeks' loads. The concentration of dissolved cadmium in the effluents, ranging from undetectable levels to 2.85 ng/L, were low whereas the concentrations in the TSS showed significant variations from undetectable concentrations to a level of 818.4 ng/L in the creek waters. The total loads were estimated as 14.7, 0.9 and 4.2 kg/year for Delicay, Cavuslu and Muftu creeks, respectively. The concentration in the TSS from the Mersin effluent was measured to be as high as 3318 ng/L in October 1992; from an average value of 881.8 ng/L for the effluent, providing 16.7 kg of Cadmium per year to the Bay.

Faecal Coliform (FC):

Faecal Coliforms, indicator organisms of microbial pollution in the marine environment, were also counted in the effluents collected at fixed locations of the three creeks and the Mersin outfall system. The number of Faecal Coliforms in 100 mL of water was in the range of 150-4000 for the three creeks, with the maximum values obtained in the summer months. On the other hand, as expected, the FC counts were very large for the Mersin effluent, ranging between 1.7×10^4 and 1.4×10^9 individuals in 100 mL of wastewater.

II.2 BIOCHEMICAL CHARACTERISTICS OF COASTAL WATERS OF MERSIN BAY

The biochemical and some pollution parameters were measured in sea water samples collected at limited number of stations. As can be seen from Figure II.1., two station grids were visited five times during 1991-1992; the one was in the vicinity of the existing Mersin Outfall and the other was across to the proposed outfall pipe and/or Cavuslu

Canal in Karaduvar region. The dates of the field studies in the Mersin Bay waters are listed below:

5/December/1991 (winter period)
29/April/1992 (spring period)
29/May/1992 (spring period)
18/August/1992 (summer period)
2/October/1992 (autumn period)

Two cruises were performed during the spring period to ensure that complete information was obtained. The results of hydrographical, biochemical and pollution parameters are given in Tables II.2., II.3., II.4., II.5. and II.6.

Distribution of Biochemical Parameters in Mersin Bay:

pH:

The pH of sea water in the Mersin Bay was observed to vary from 8.00 to 8.36 throughout the whole sampling period, indicating that the measured pH values are very similar to those from offshore waters. As is well known, sea water is a strong buffer and thus, its pH can only be changed significantly if a large volume of polluted waters with very low or very high pH values (due to strong acidic or basic pollutants) are provided to the receiving marine environments. As discussed in Sec. II.1. there are no acidic and/or basic waste water discharges into the Mersin coastal waters from land-based sources.

Total Suspended Solids (TSS):

The seasonal variations of Total Suspended Solids (TSS) in the study area are presented in Figure II.2. as bar graphics. In general, TSS ranged between 2.6 and 120.0 mg/L and relatively high values were observed in the vicinity of the existing outfall; e.g. Stations M18, M19, M20 and M24 and in the coastal stations of the Karaduvar grid,

M1, M2, M3, M4. Most values were in the range of 5-20 mg/L, and were similar to our previous measurements in the coastal waters of Northeastern Mediterranean. The TSS concentrations for offshore waters, as low as as 2 mg/L, are close to data from the other regions of the Eastern Mediterranean, resulting in penetration of solar light to depths (Berman et al., 1984; Yilmaz et al., 1992b). However, the relatively high concentrations of TSS determined in the Mersin Bay led to measures of Secchi Disc Depths, ranging between 0.5 and 4m at the same locations. These values are very low when compared to Secchi Disc Depths exceeding 25-30m in the offshore waters of the Northeastern Mediterranean for most of the year (Yilmaz et al., 1992b).

Dissolved Oxygen (DO):

Dissolved oxygen in sea water is very important for all aerobic organisms in marine environments; e.g. fishes cannot survive or aerobic decomposition of organic matter by microorganisms in water and sediment layers stops when the oxygen concentration in water decreases below certain levels. The oceanographic investigation carried out in 1991-1992 showed that the Dissolved Oxygen (DO) ranged between 5.29 and 11.90 mg/L in the waters of Mersin Bay. The seasonal distribution of DO in the study area is given in Figure II.3; during the mixing seasons, winter and early spring, the concentrations of DO in subsurface waters were observed to be relatively high at all locations visited in the bay. The values exceeding 8 mg/L that were obtained during the April 1992 cruise were very close the saturation values of DO in seawater probably due to both atmospheric input and production by photosynthetic organisms. During the summer-autumn period, the thermocline established in subsurface waters prevented the diffusion of DO from the surface to the depths. Thus, DO decreased remarkably with depth at the stations affected directly by wastewater discharges of terrestrial origin. The DO concentration in the surface waters decreases with the increase in the water temperature during the summer due to the poor solubility of atmospheric oxygen in water at higher temperature.

Biochemical Oxygen Demand (BOD₅):

The Biochemical Oxygen Demand (BOD₅) measured in the subsurface waters of the Mersin Bay was generally less than 5 mg-O₂/L, ranging from undetectable levels (<0.1 mg/L) to 10.3 mg-O₂/L. The lowest BOD₅ values were obtained in December 1992 and the highest values appeared in August 1992 when the oxygen demand of microorganisms increased substantially in parallel to the increase in the biodegradable organic matter content of the sea water. As expected the largest BOD₅ values were recorded at the locations under the direct influence of the Mersin effluent (Stations M18, M19, M20 M23, M24) and at stations M1, M2, M3 and M4 in the Karaduvar region (Figure II.4.).

Chemical Oxygen Demand (COD):

The Chemical Oxygen Demand (COD) measured in Mersin Bay in the period December 1991 - October 1992 are presented in Figure II.5. The maximum COD concentrations, as large as 23.9 mg-O₂/L, were observed in August 1992 at stations M18, M19 and M20 which were close to the existing outfall system. The minimum COD values, as low as 0.52 mg/L, appeared at offshore stations.

Inorganic Phosphate (o-PO₄-P):

The seasonal distribution of dissolved inorganic phosphate are displayed in Figure II.6. At the polluted locations , e.g. Stations M18-M30, the phosphate concentrations were relatively high throughout the year. In the region influenced by the fresh waters of Cavuslu creek the concentrations were also higher than in the less polluted locations. The level of inorganic phosphate concentrations was found to range between 0.02 μM and 20.32 μM in the coastal waters of the Mersin Bay. The eastern Mediterranean Sea is known to be impoverished in primary nutrient elements (phosphate and nitrate) and particularly the phosphate concentration diminishing below 0.02-0.03 μM levels in the surface waters of the open waters, is very likely to limit

phytoplankton production in the Levantine Basin (Krom et al., 1991).

Total Oxidized Nitrogen (NO_3+NO_2-N) :

As previously mentioned in Sec. II.1., the nutrient inputs to the surface waters of the coastal regions originate primarily from terrestrial sources and partly from regenerative processes within the system. Figure II.7. shows the seasonal variation of total oxidized nitrogen (nitrate + nitrite) in Mersin Bay in the period from December 1991 to October 1992.

Relatively high concentrations of nitrate + nitrite in sea water were observed in the Karaduvar region where the Cavuslu creek carries the highest nitrogenous material when compared with the other creeks and the Mersin effluent. At the stations located near the existing sewerage outfall the concentrations in subsurface seawater were also relatively high. As shown in Tables II.2. - II.6, the concentrations of total oxidized nitrogen ranged between 0.07 and 36.20 μM in the Bay waters.

Faecal Coliform (FC):

The Faecal Coliform bacteria analysis carried out in the waters of the Mersin Bay on a seasonal basis showed that the Bay waters were microbially polluted due to the input of large quantities of the domestic waters into the Bay. Figure II.8. shows the seasonal distributions of Faecal Coliform counts determined at selected stations in the Mersin Bay. The FC limit given by the World Health Organization (WHO) for bathing waters or/and for very near coastal waters is 100 #/ 100 mL of sea water though this limit has often been altered by national authorities. In the Mersin Bay the FC ranged from insignificant numbers (<10) to levels as large as 3.000.000 #/100 mL of sea water. The highest counts were obtained in the vicinity of the existing outfall. Occasionally the FC determined in the Karaduvar region also exceeded the WHO limit, indicating microbial pollution of

fresh water origin.

II.3 T-90 DETERMINATION AND RHODAMINE DYE TRACING

In order to determine the time necessary for the decay of 90% of FC of domestic origin in the receiving bay waters, T-90 measurements together with a Rhodamine-B dye tracing experiment were carried out in the vicinity of the existing outfall in Mersin Bay in October 1992. In this work, 5 liters of Rhodamine-B solution containing 2 kg of dye dissolved in acetic acid was introduced instantaneously to the surface waters of the bay at the discharge point of Mersin domestic waters. Then the cloud of dye was followed using a sensor sensitive only to the dye (*in situ* fluorometer probe) giving the real time concentrations at selected stations. The data obtained *in situ* and calibrated later are depicted in Figure II.9. The location of all the stations where the dye concentrations were measured were determined by using a Decca Trisponder Navigation system . As can be seen from Figure II.9a, the time intervals between the measurements at two different stations were in the range of 4-19 minutes. At each station, sea water samples were also taken for the further fluorometric analyses with a bench type Spectrofluorometer and for the determination of Faecal Coliform in the same samples. The results of laboratory fluorescence measurements are shown in Figure II.9b . The dye patch could be followed for about two and a half hour until it became too diluted for fluorometric analysis. As can be seen from Figure II.9b, the dye became broken up into two patches. The main branch flowing in the east direction was monitored first. The second branch was directed first towards the west and then to the north-west direction (Figure II.9b.). The dye clouds were monitored until a dilution factor of 10^4 appeared at St. R8 in the west and Sts. R7, R10, R14, R15 in the eastern side of the outfall. A similar dilution trend in the FC values was obtained from the direct FC measurements in sea water; the results are depicted in Figure II.9c. In determining the T-90 values for FC in the sea waters under the environmental factors of October 1992, the FC data should show a decreasing trend in parallel to the dilution in the dye

concentrations. However, the correlation is not strong due to contamination of the dye-containing water parcels with the surrounding waters having various levels of FC and decay of FC during their transport from source to the nearby area. Accordingly, at the eastern side of the existing outfall, a fluctuation appeared in the Faecal Coliform counts in the west-east direction. Nevertheless, T-90 value estimated from the data was in the range of 1 to 2 hours (for October).

As discussed in Sec. II.2. and depicted in Figure II.10, the distribution of Faecal Coliform is determined by a number of domestic discharges in various flows as well as the flow of the creeks and the physical and biochemical processes interacting in the area. The Faecal Coliform and current measurements should be considered together in order to recalculate the T-90 value, and if the mean current is approximately 20-50 cm/sec, (Sec. I.), and if the distance between the main source and the station where the number of Faecal Coliforms are close to zero is in the range of 500-1000 m, the T-90 value can be recalculated to lie in the range of e.g. >1 hour and <1.5 hours for the Mersin Bay.

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APPENDIX A

ABBREVIATION

Symbol	Unit	Remark
T	°C	Temperature
S	‰, ppt, psu	Salinity
SD	m	Secchi Disc Depth
pH	-	Acidity
TSS	mg/L	Total Suspended Solid
DO	mg/L	Dissolved Oxygen
BOD ₅ *	mg/L	Biochemical Oxygen Demand (5 days)
COD	mg/L	Chemical Oxygen Demand
o-PO ₄ ⁻ P	μM	Ortho-phosphate
NO ₃ ⁻ +NO ₂ ⁻ N	μM	Total Oxidized Nitrogen (Nitrate+Nitrite)
FC	#/100mL	Faecal Coliform
Tot-P	μM	Total Phosphorus (Organic + Inorganic)
PAH	μg/L	Polyaromatic Petroleum Hydrocarbons
Hg	ng/L	Total Mercury in water
Cd	ng/L	Total Cadmium in water
Cd _{TSS}	ng/L	Total Cadmium in suspended solid

* because of the high chloride content of seawater, COD was measured in the particulate fraction by filtering seawater through glass fiber filters.

APPENDIX B

METHODOLOGY:

Parameter	Symbol	Outline of Method	Detection Limit	Reference
Dissolved Oxygen	DO	Winkler Titration	3 μ M	Strickland and Parsons, 1972
Total Suspended Sediment	TSS	Gravimetric	0.1 mg	APHA, AWWA, WPCF Standard Methods 1980
o-Phosphate	PO ₄ -P	Phospho-molybdate complex formation Autoanalyzer	0.02 μ M	Strickland and Parsons 1972 Grasshoff, 1976
Nitrate+ Nitrite	NO ₃ +NO ₂	Cd-Cu reduction Azo-dye formation Autoanalyzer	0.05 μ M	Strickland and Parsons 1972 Grasshoff, 1976
Faecal Coliform	FC	Membrane Filtration	93%	APHA, AWWA, WPCF 1980
Biochemical Oxygen Demand	BOD ₅	Incubation at 20°C/5days Winkler Titration or DO probe	0.1 mg/L	Strickland and Parsons, 1972
Chemical Oxygen Demand	COD	Oxidation with K ₂ Cr ₂ O ₇ +H ₂ SO ₄ Titrimetric	0.1 mg/L	APHA, AWWA, WPCF 1980
Petroleum Hydrocarbons	DDPH (PAH)	n-hexane extraction Fluorometric	0.01 μ g/L	UNESCO, 1984 UNEP, 1986
Mercury	Hg(water)	Cold vapor, AAS	0.25ng	Yemenicoglu, 1980
Cadmium	Cd(water)	Aqua Regia digestion Flameless AAS	0.02ng	Ediger et al., 1974
	Cd(sed)	Hot NO ₃ digestion	0.02ng	"
Total Phosphorus	T-P	Permullphate oxidation, phospho molybdate complex formation Spectrophotometry or Autoanalyzer	0.1 μ M	Strickland and Parsons, 1972; FAO Fisheries Tech. Rep. No: 137, 1975

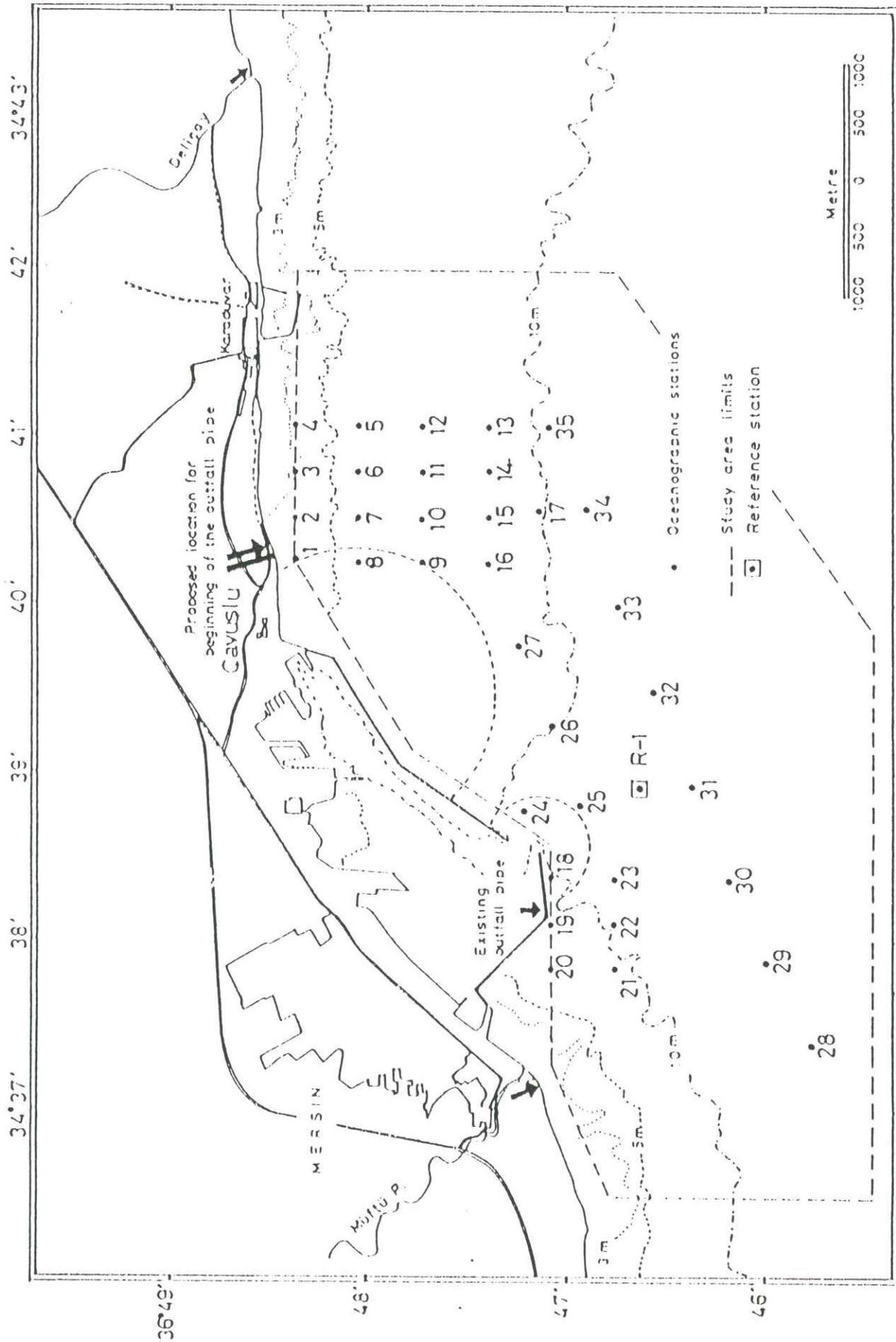


Fig.I.1 Station locations

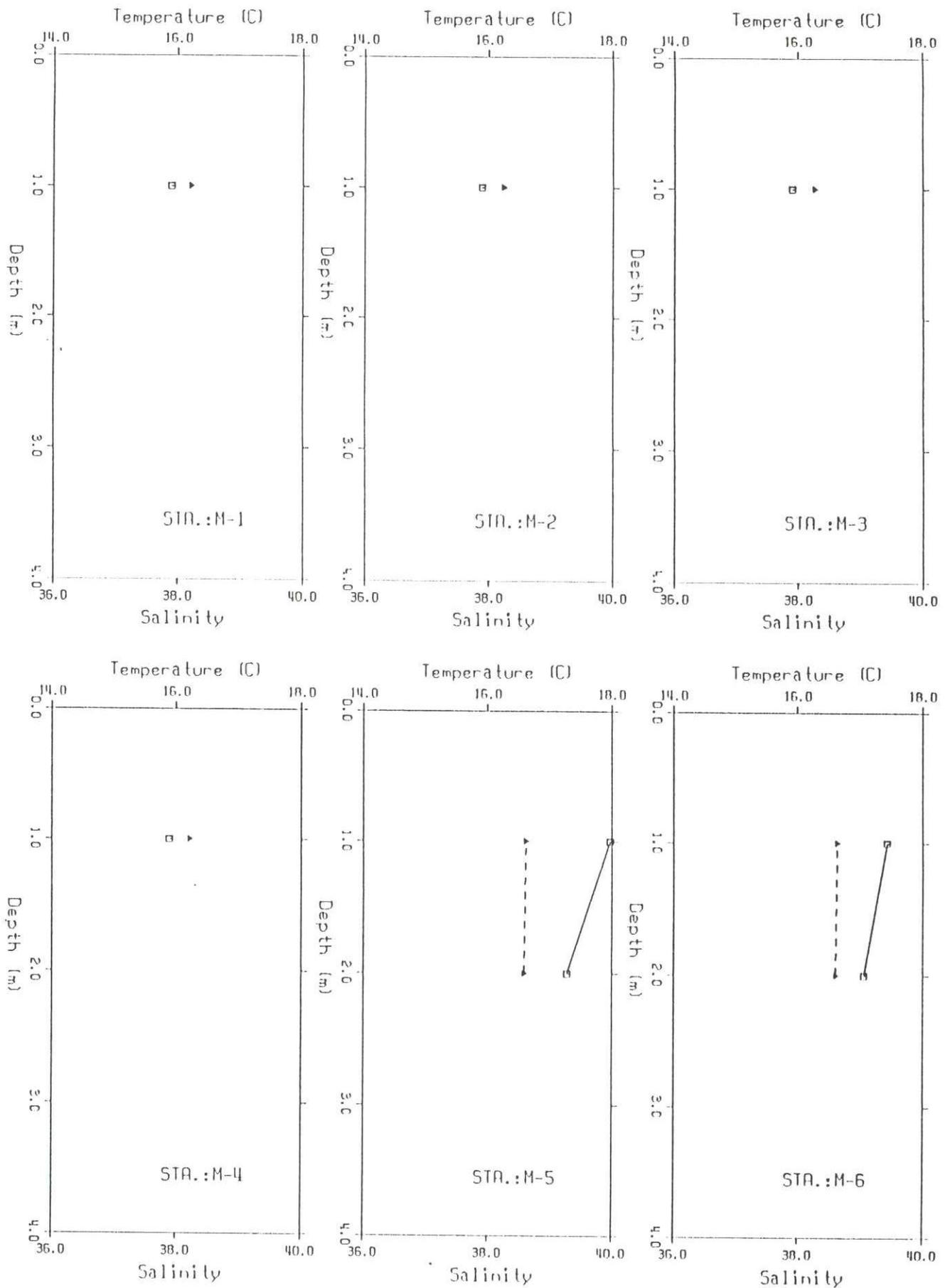


Fig.I.2 Temperature and salinity profiles, Dec. 1991

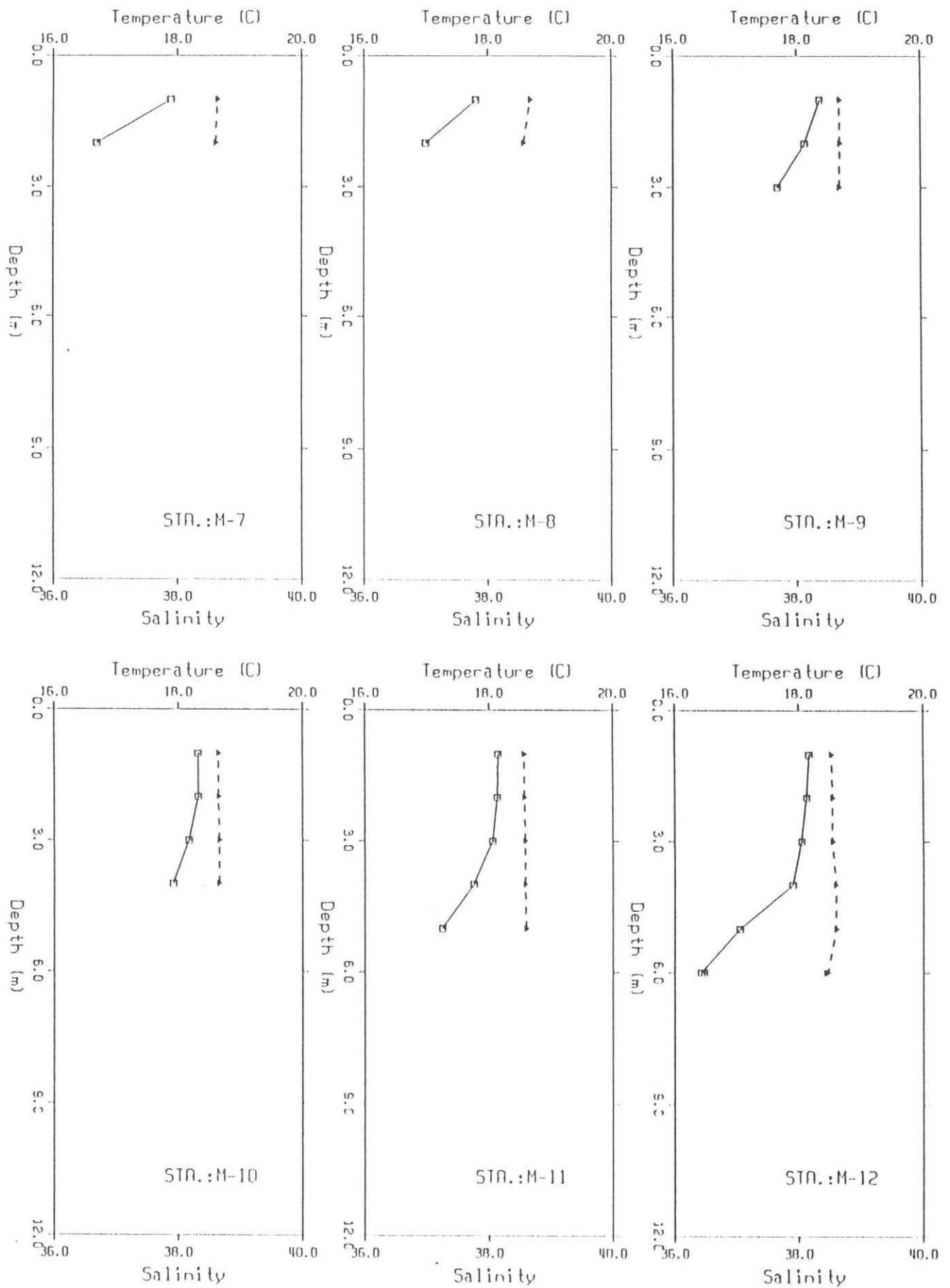


Fig.I.2 Temperature and salinity profiles, Dec. 1991

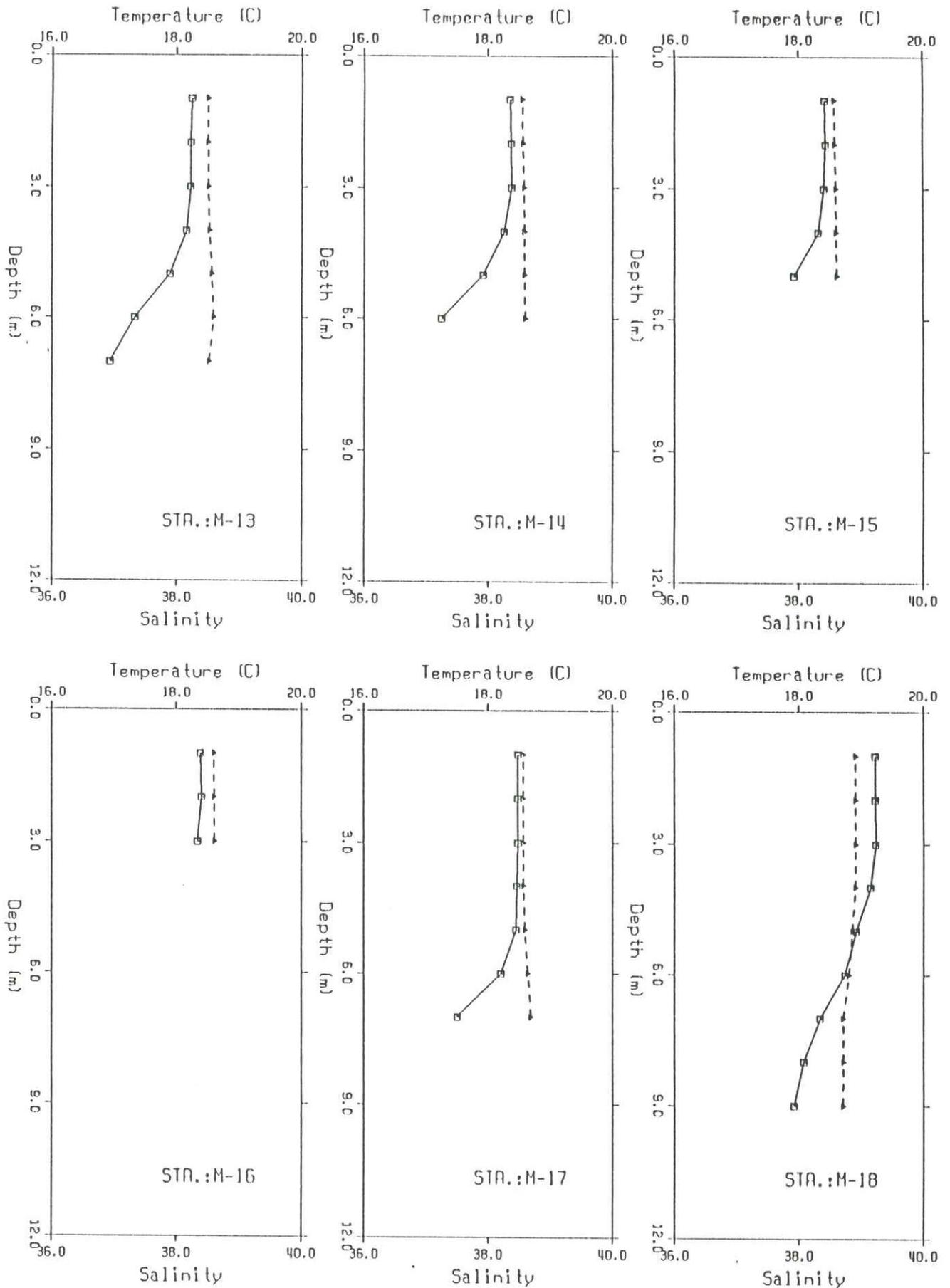


Fig.I.2 Temperature and salinity profiles, Dec. 1991

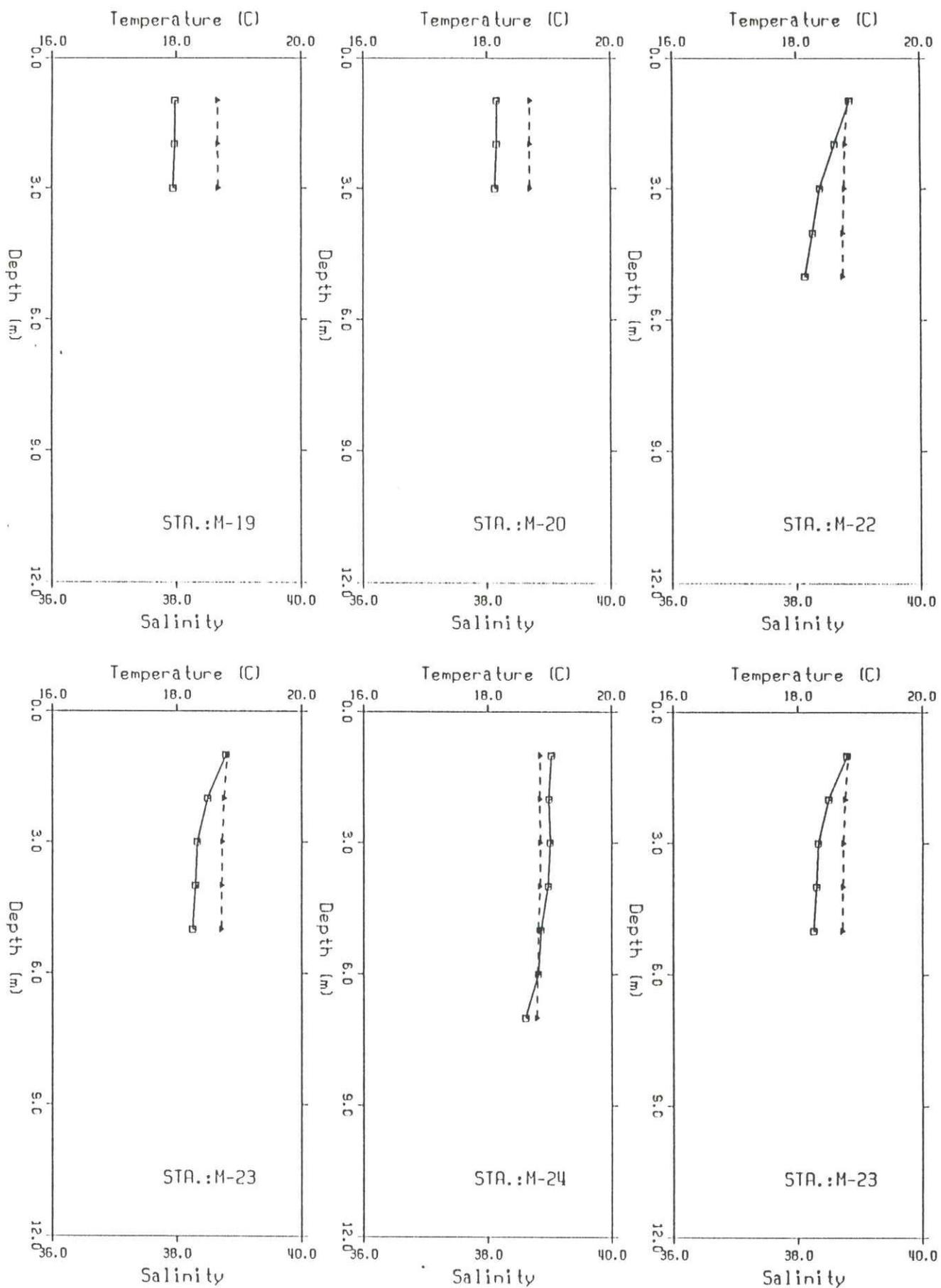


Fig.I.2 Temperature and salinity profiles, Dec. 1991

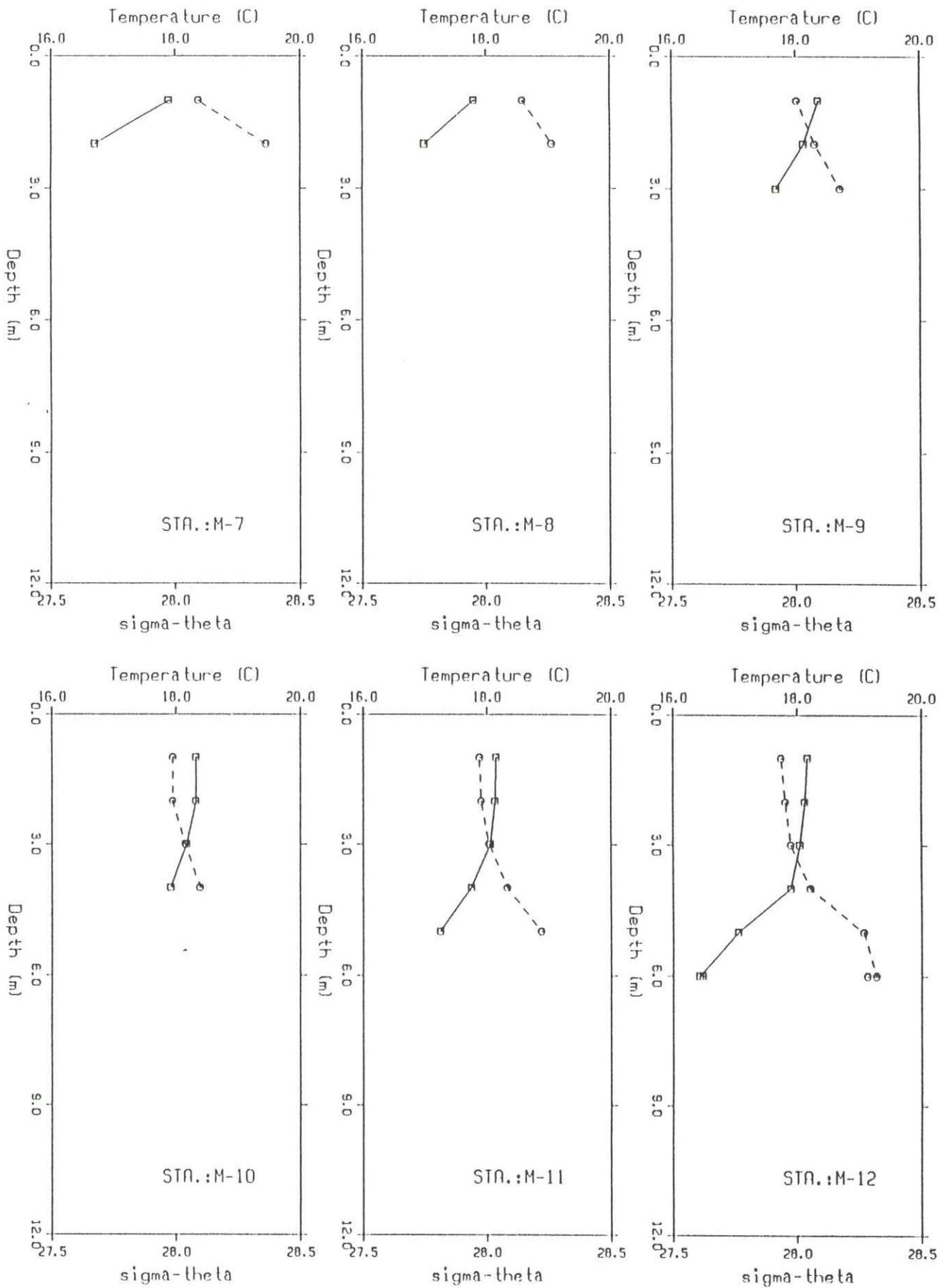


Fig.I.2 Temperature and density profiles, Dec. 1991

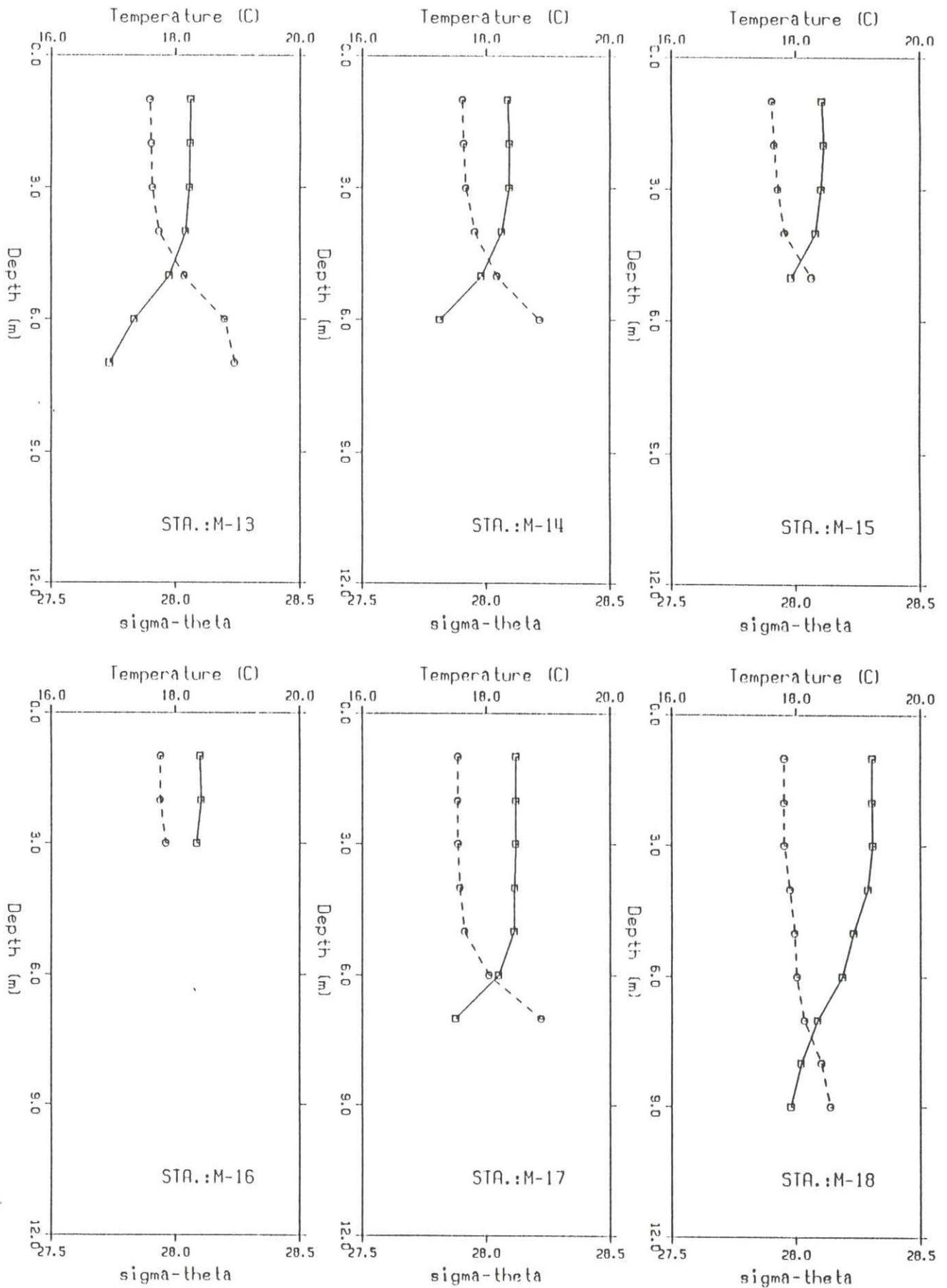


Fig.I.2 Temperature and density profiles, Dec. 1991

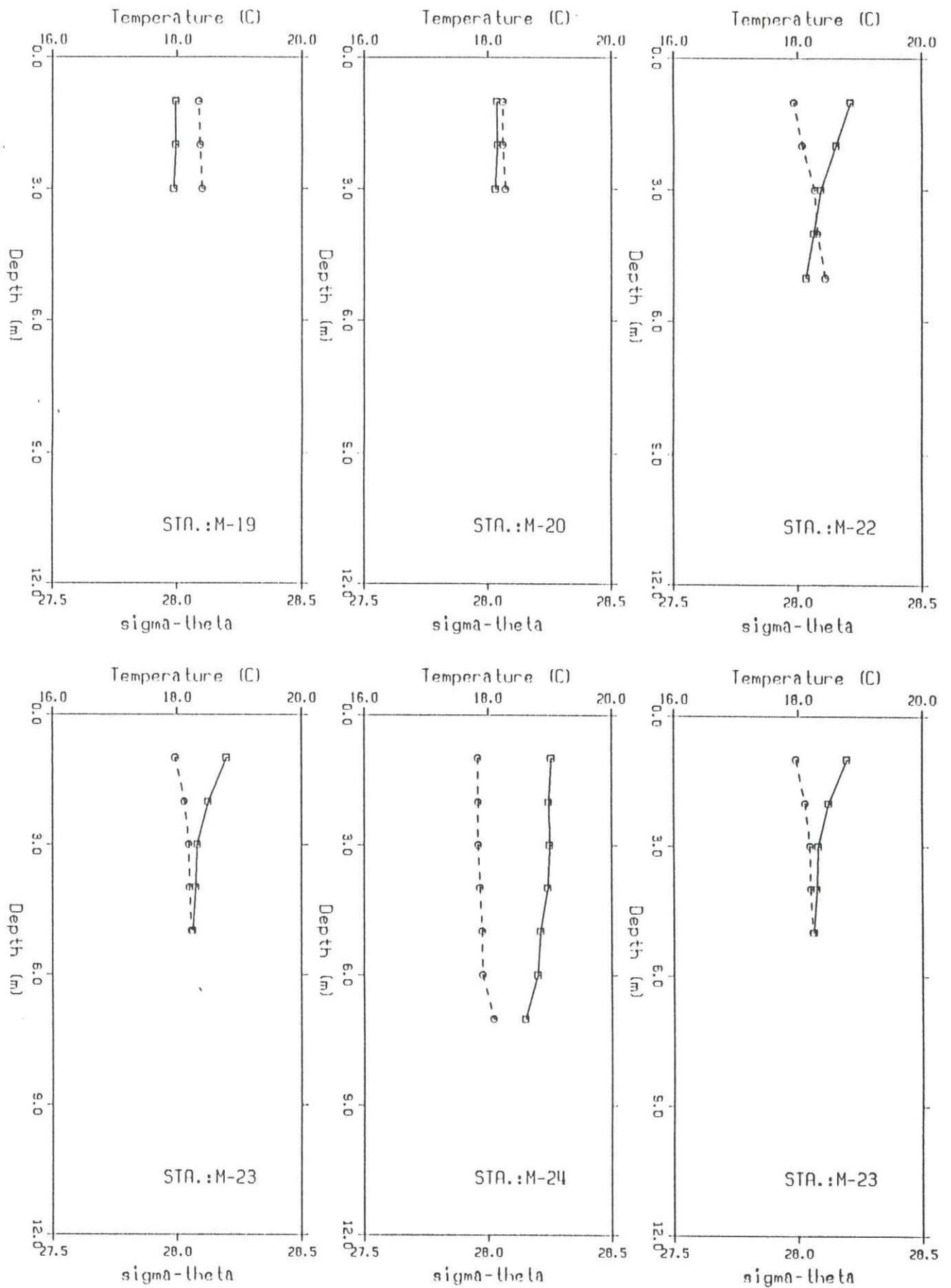


Fig.I.2 Temperature and density profiles, Dec. 1991

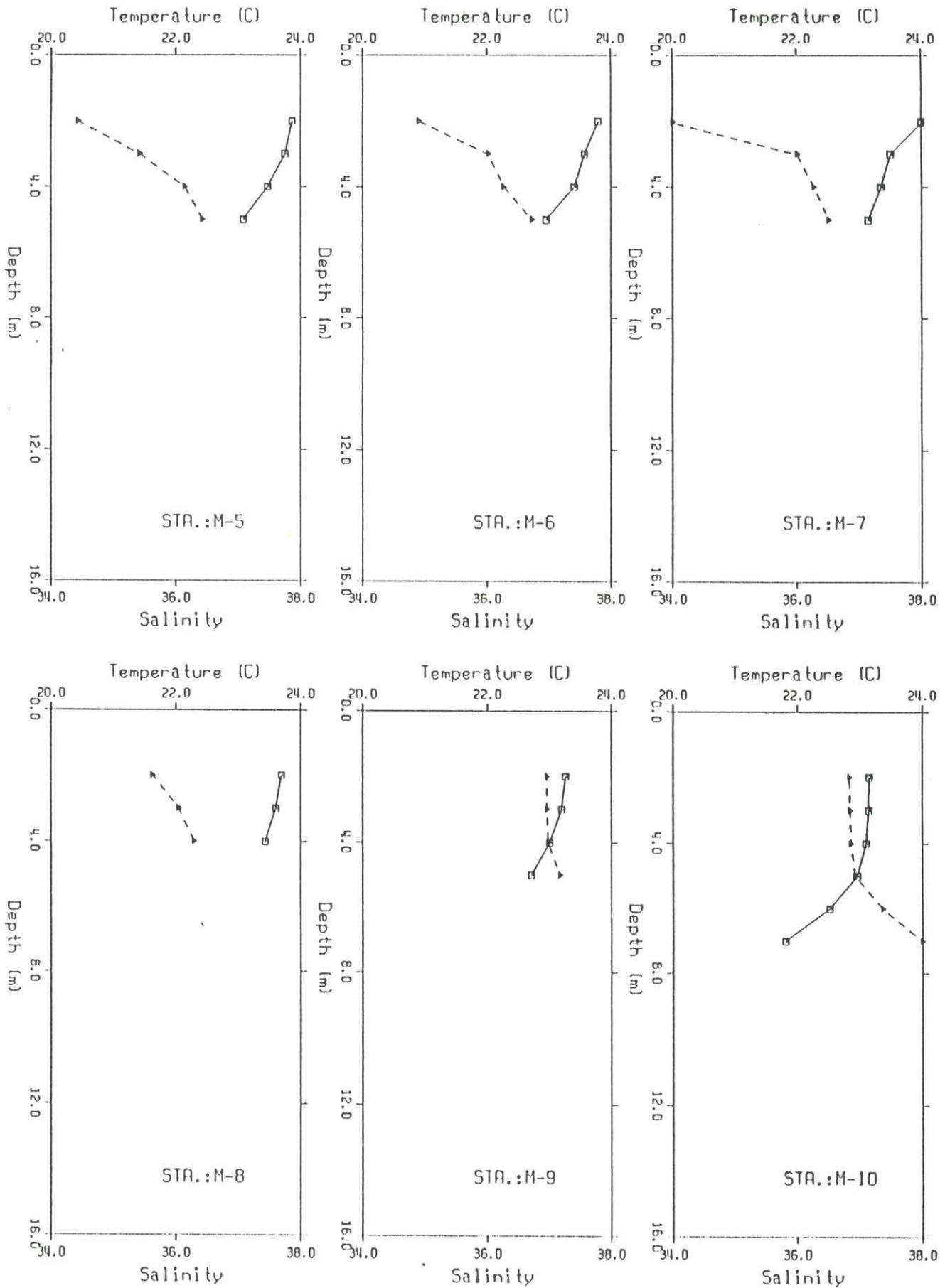


Fig.I.3 Temperature and salinity profiles, May 1992

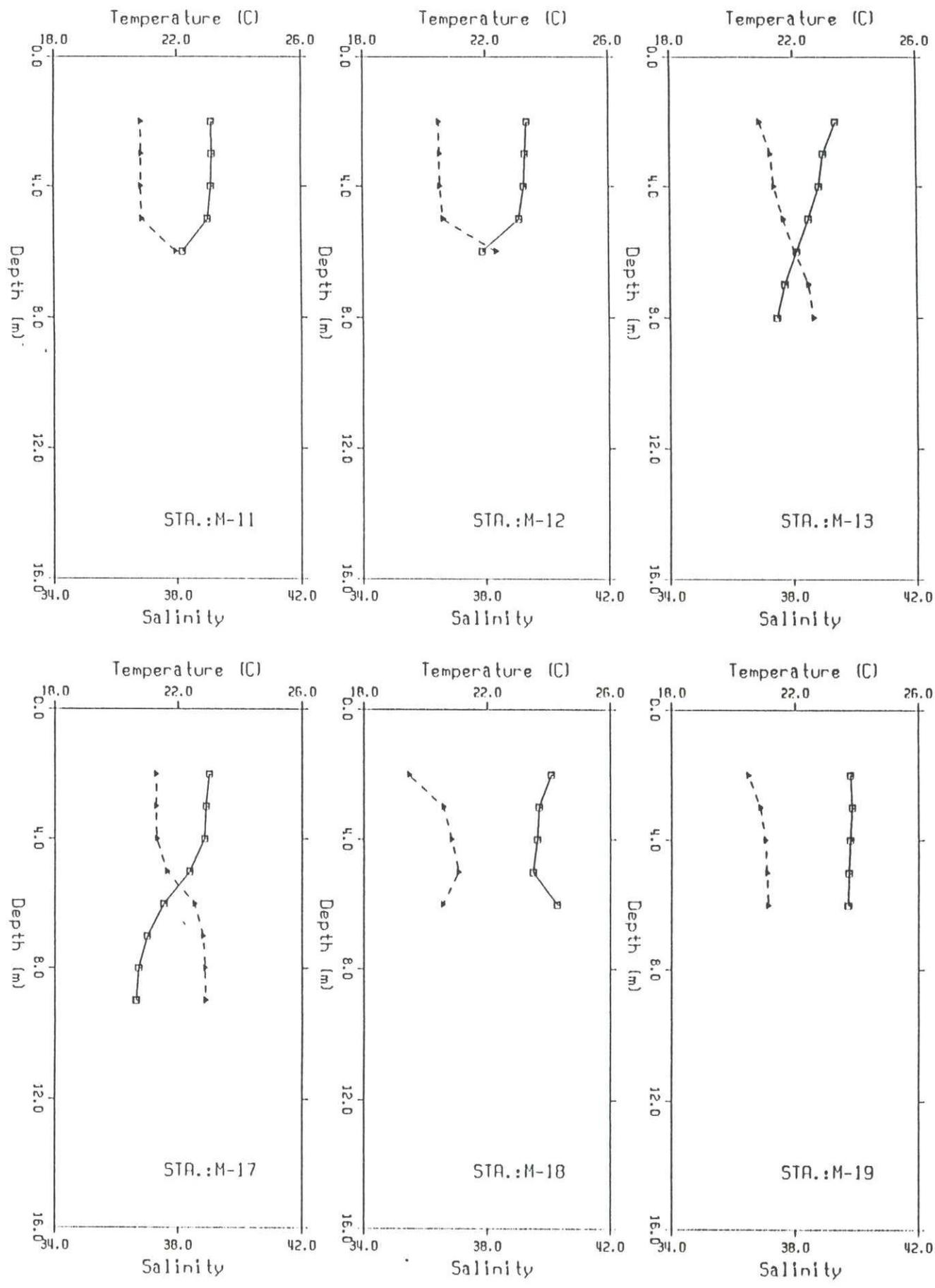


Fig.I.3 Temperature and salinity profiles, May 1992

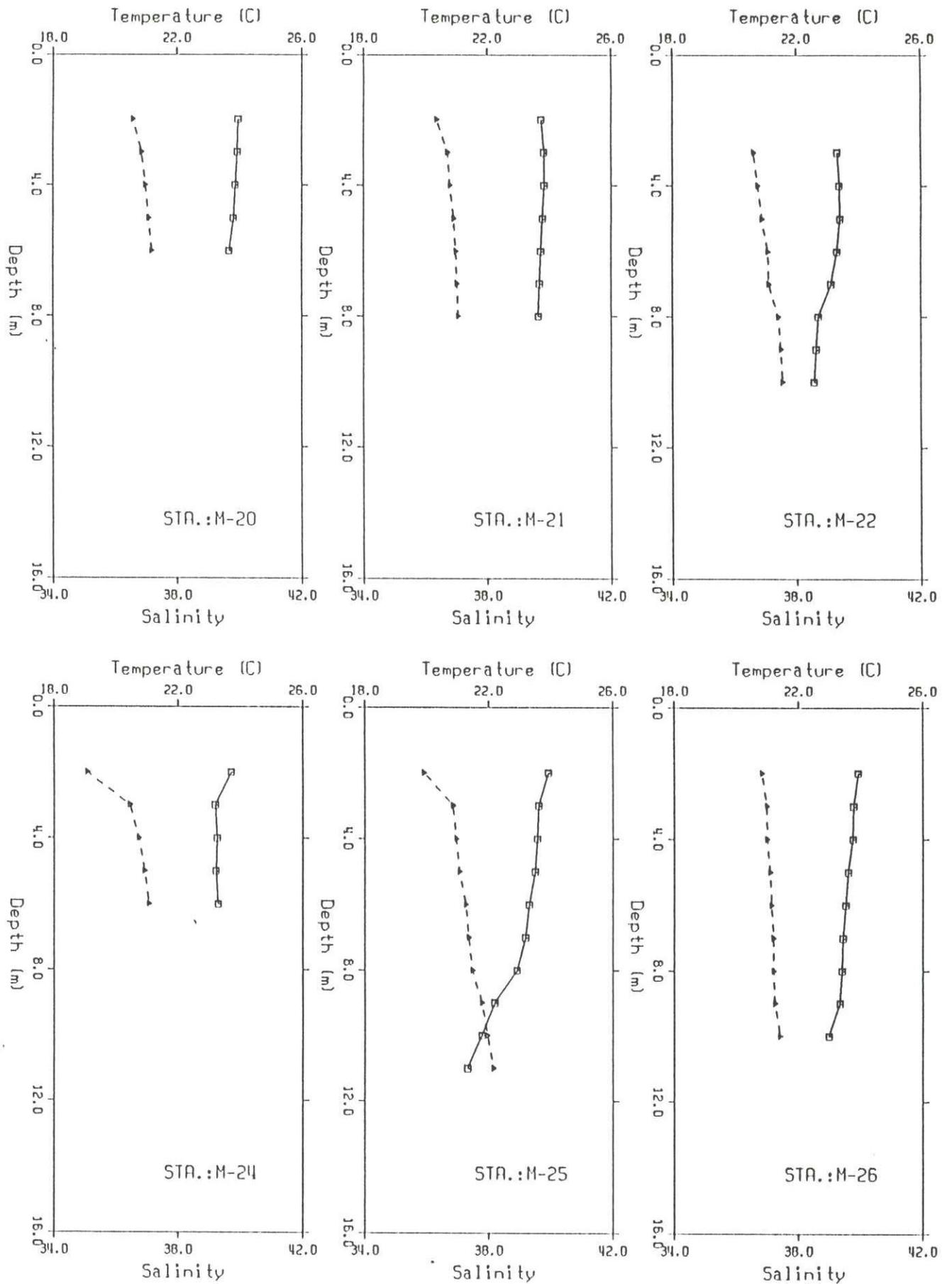


Fig.I.3 Temperature and salinity profiles, May 1992

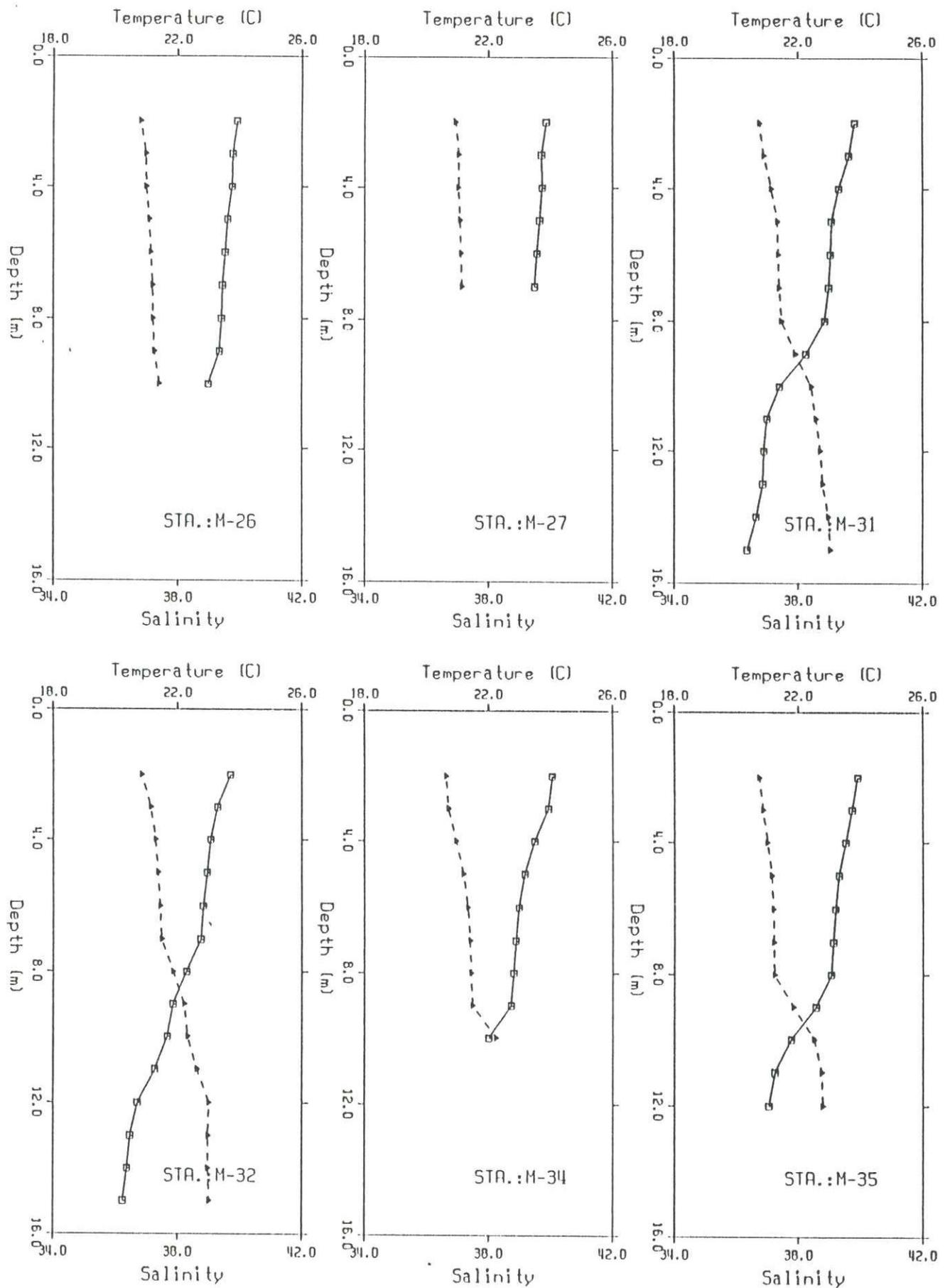


Fig.I.3 Temperature and salinity profiles, May 1992

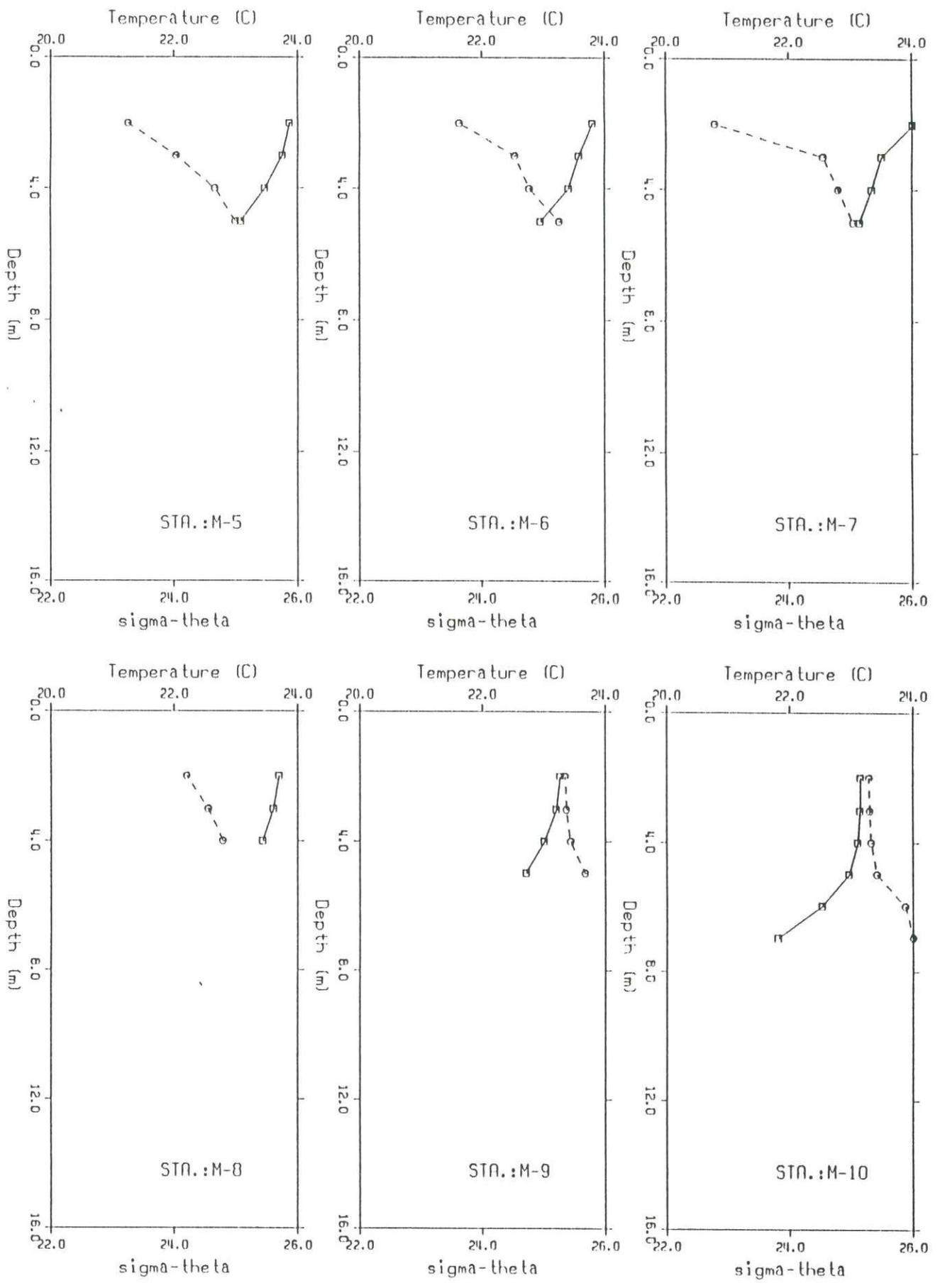


Fig.I.3 Temperature and density profiles, May 1992

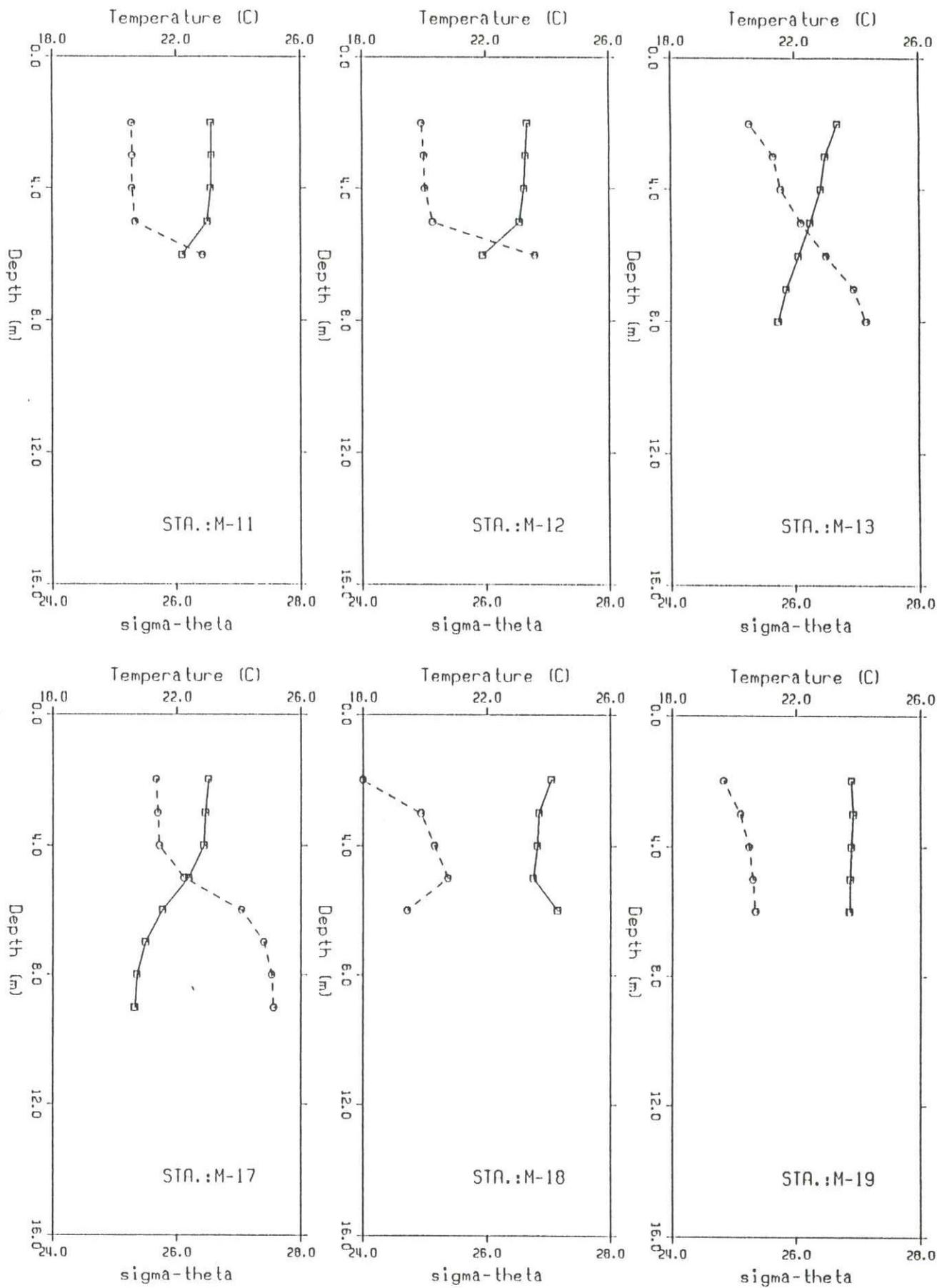


Fig.I.3 Temperature and density profiles, May 1992

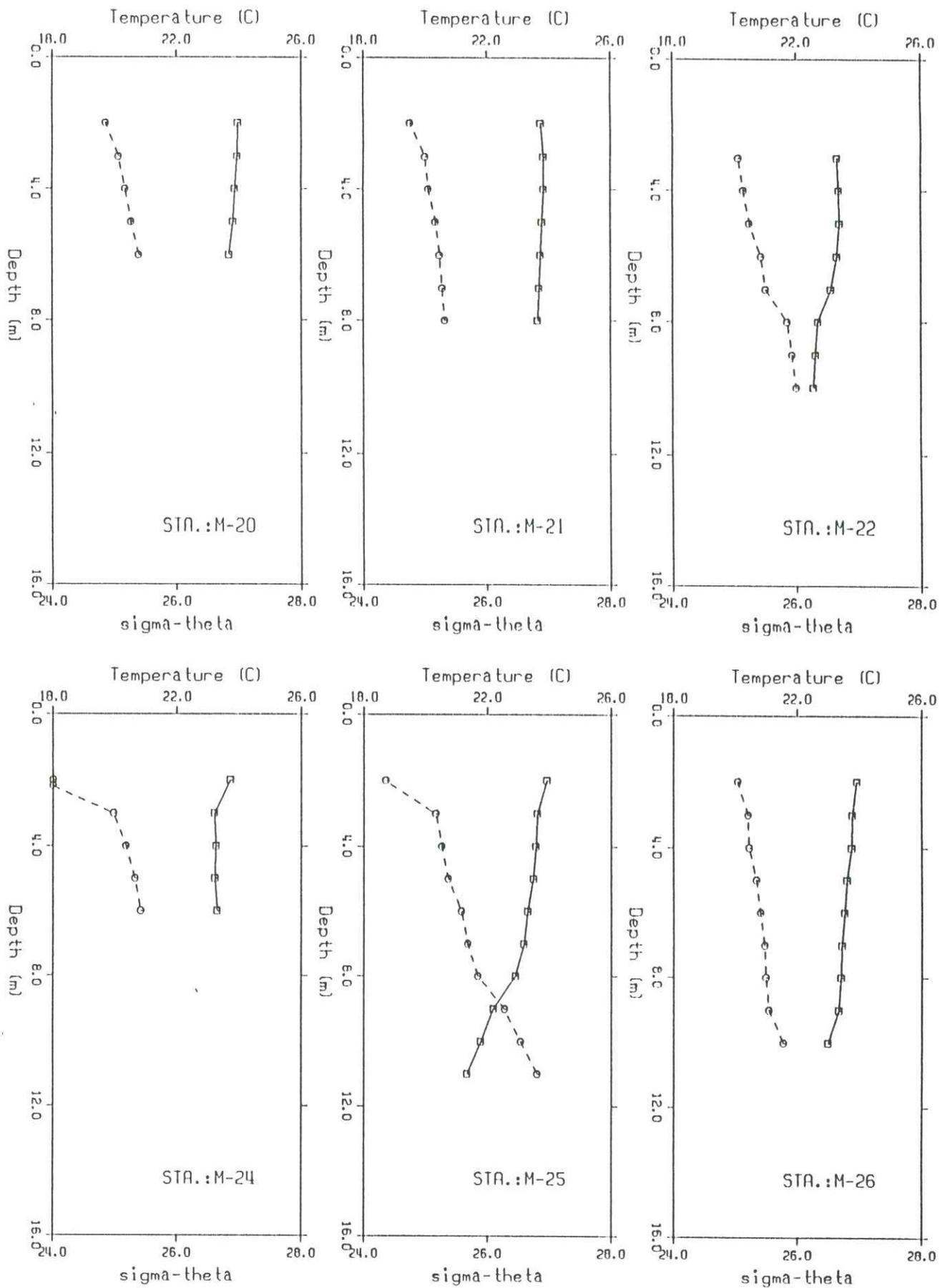


Fig.I.3 Temperature and density profiles, May 1992

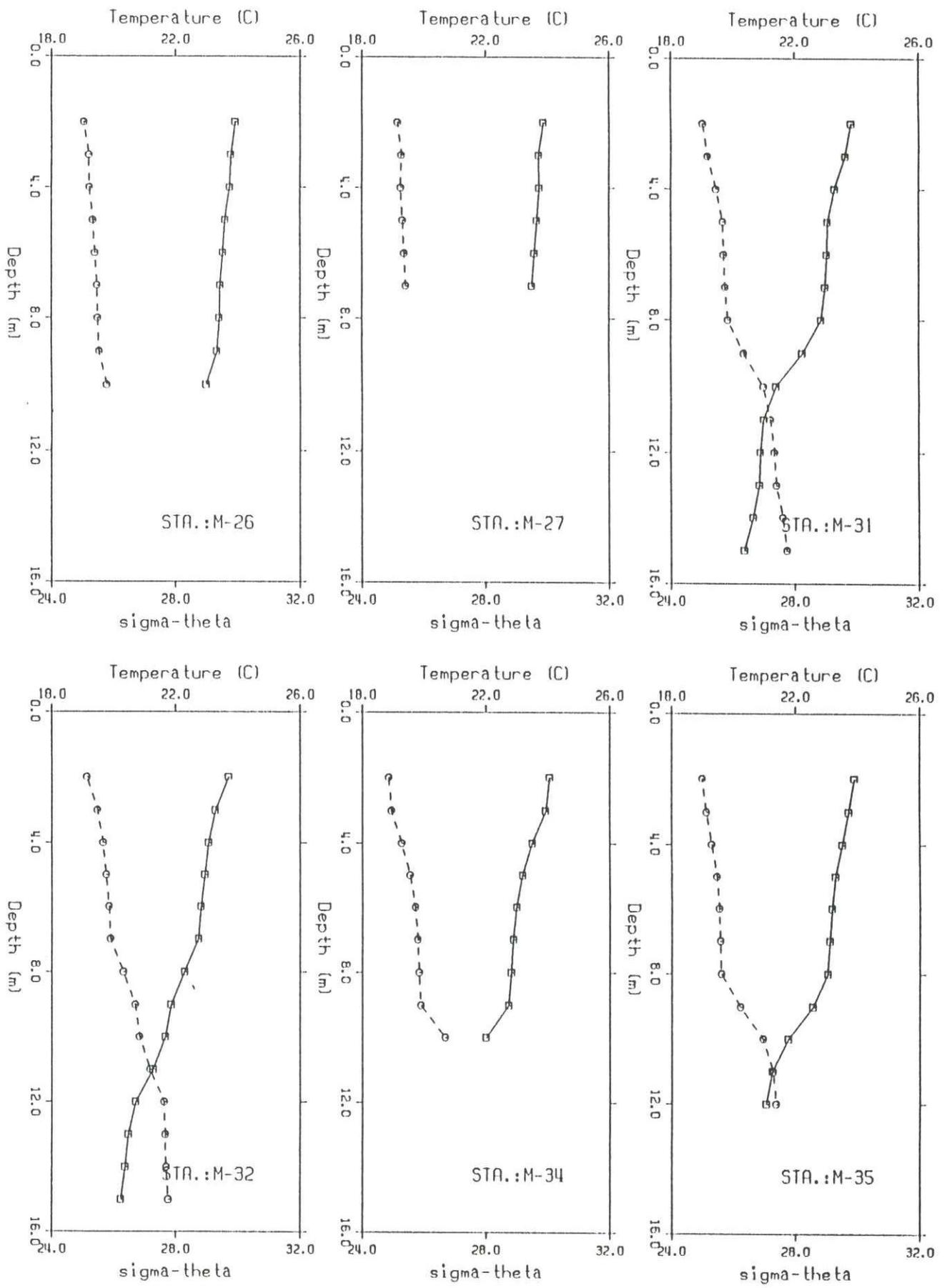


Fig.I.3 Temperature and density profiles, May 1992

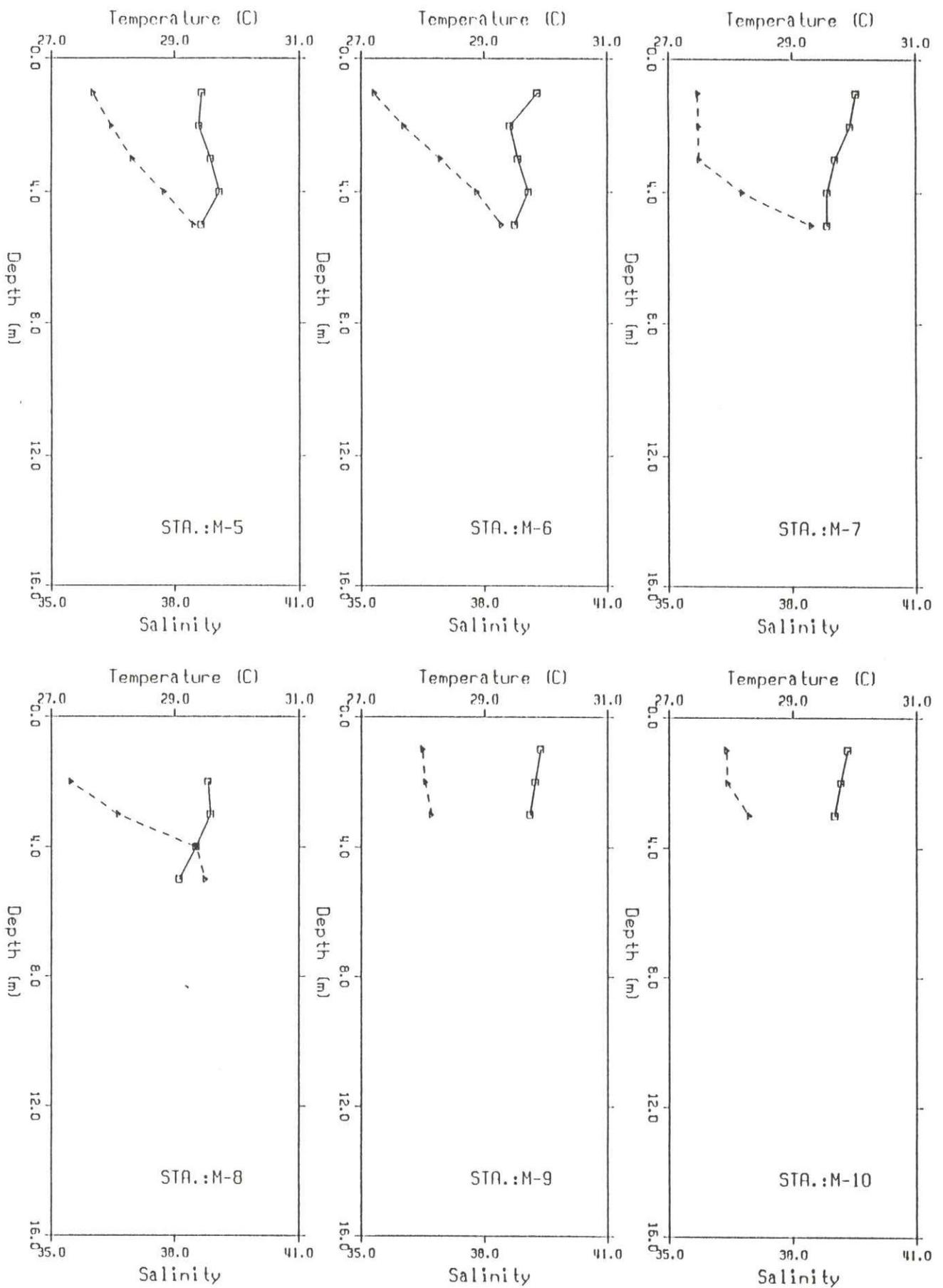


Fig.I.4 Temperature and salinity profiles, Aug 1992

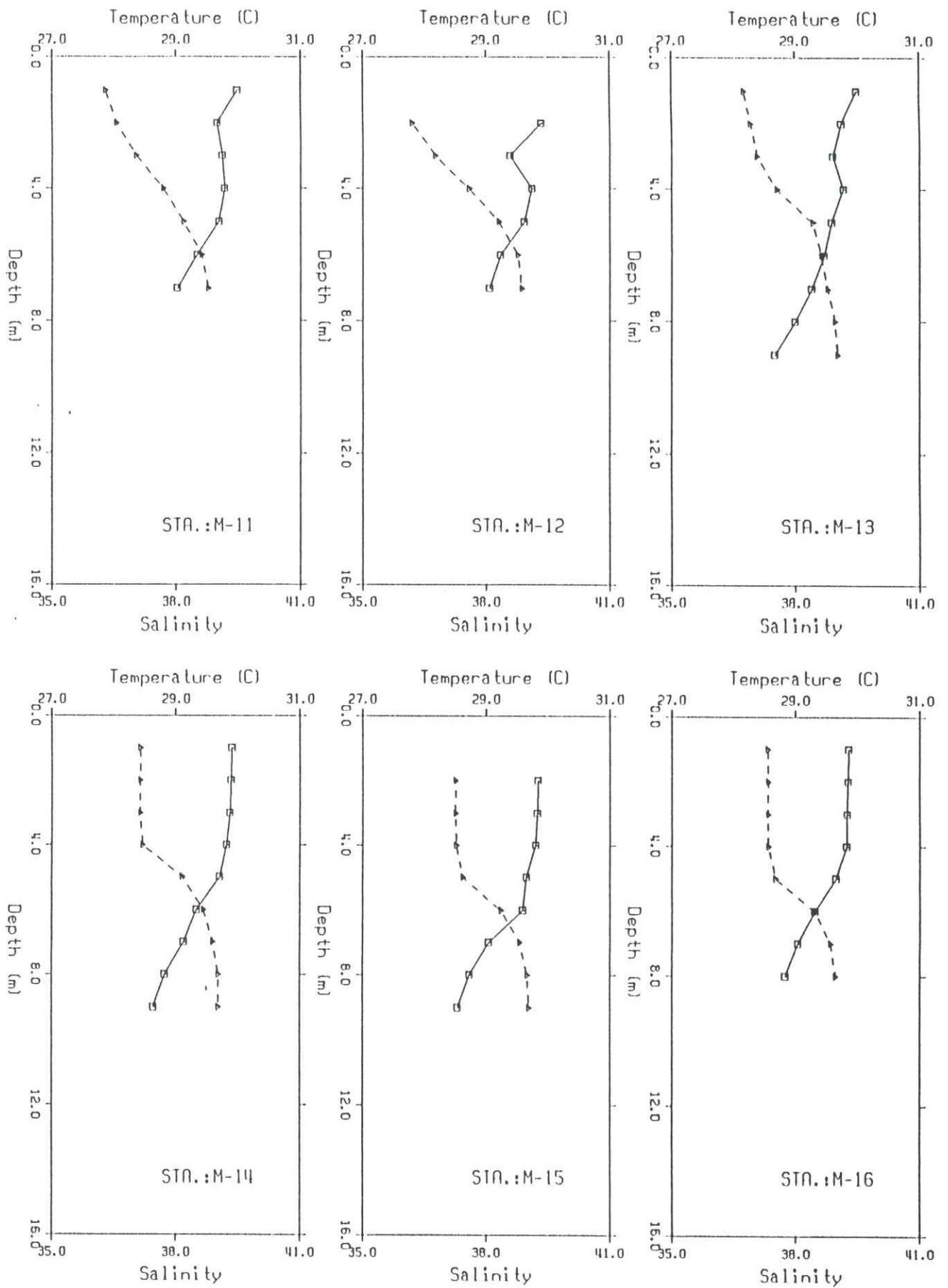


Fig.I.4 Temperature and salinity profiles, Aug 1992

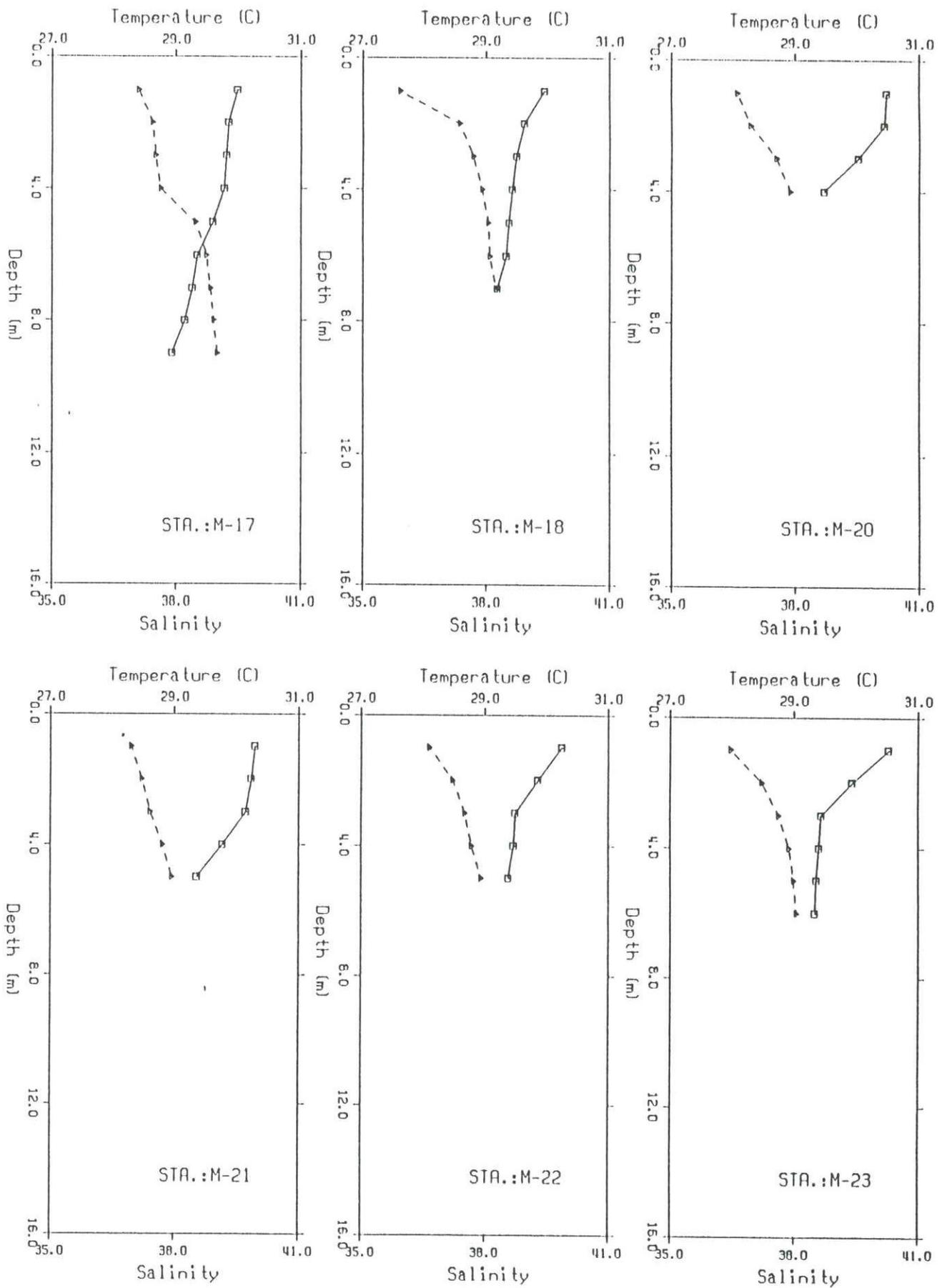


Fig.I.4 Temperature and salinity profiles, Aug 1992

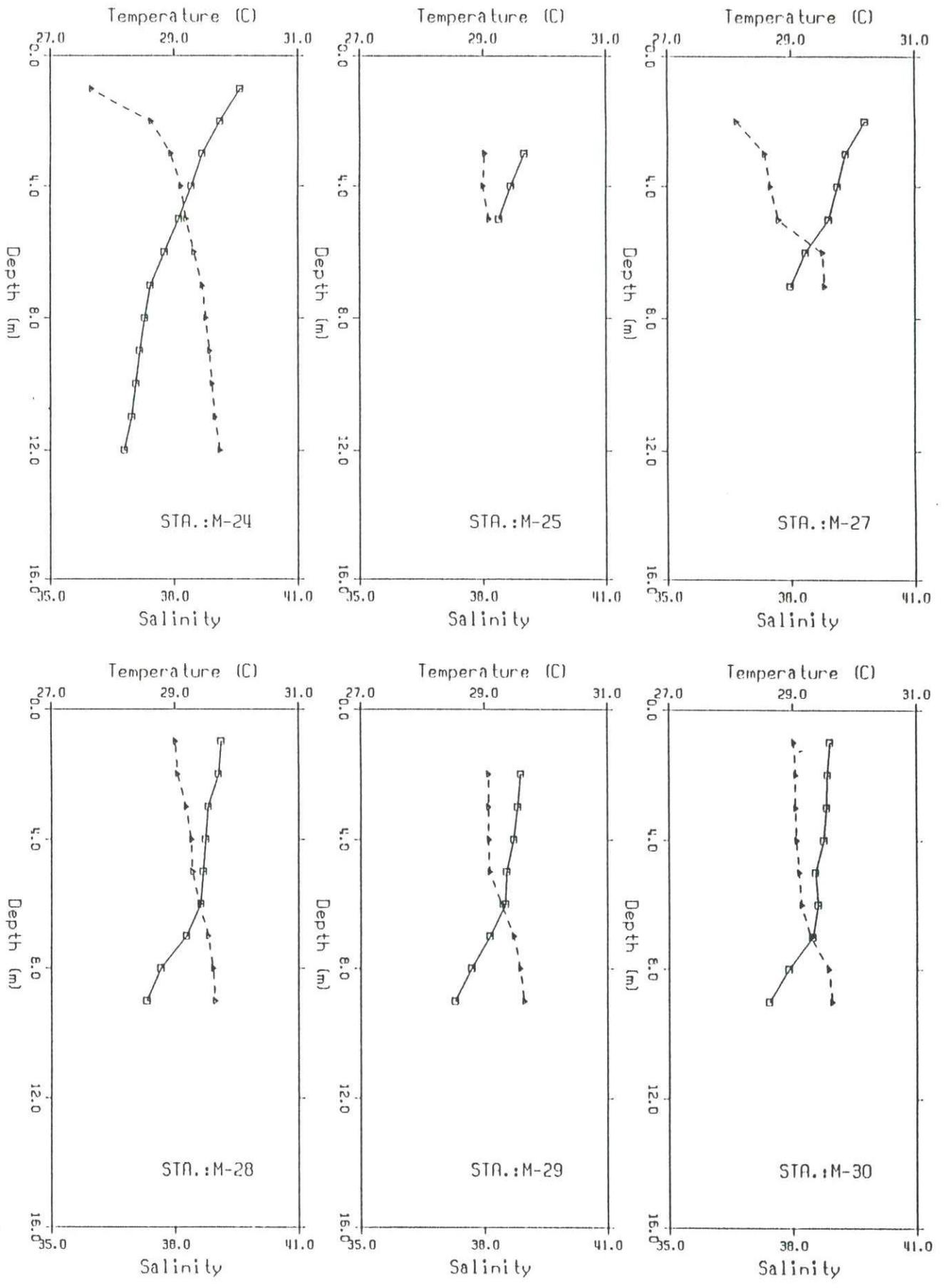


Fig.I.4 Temperature and salinity profiles, Aug 1992

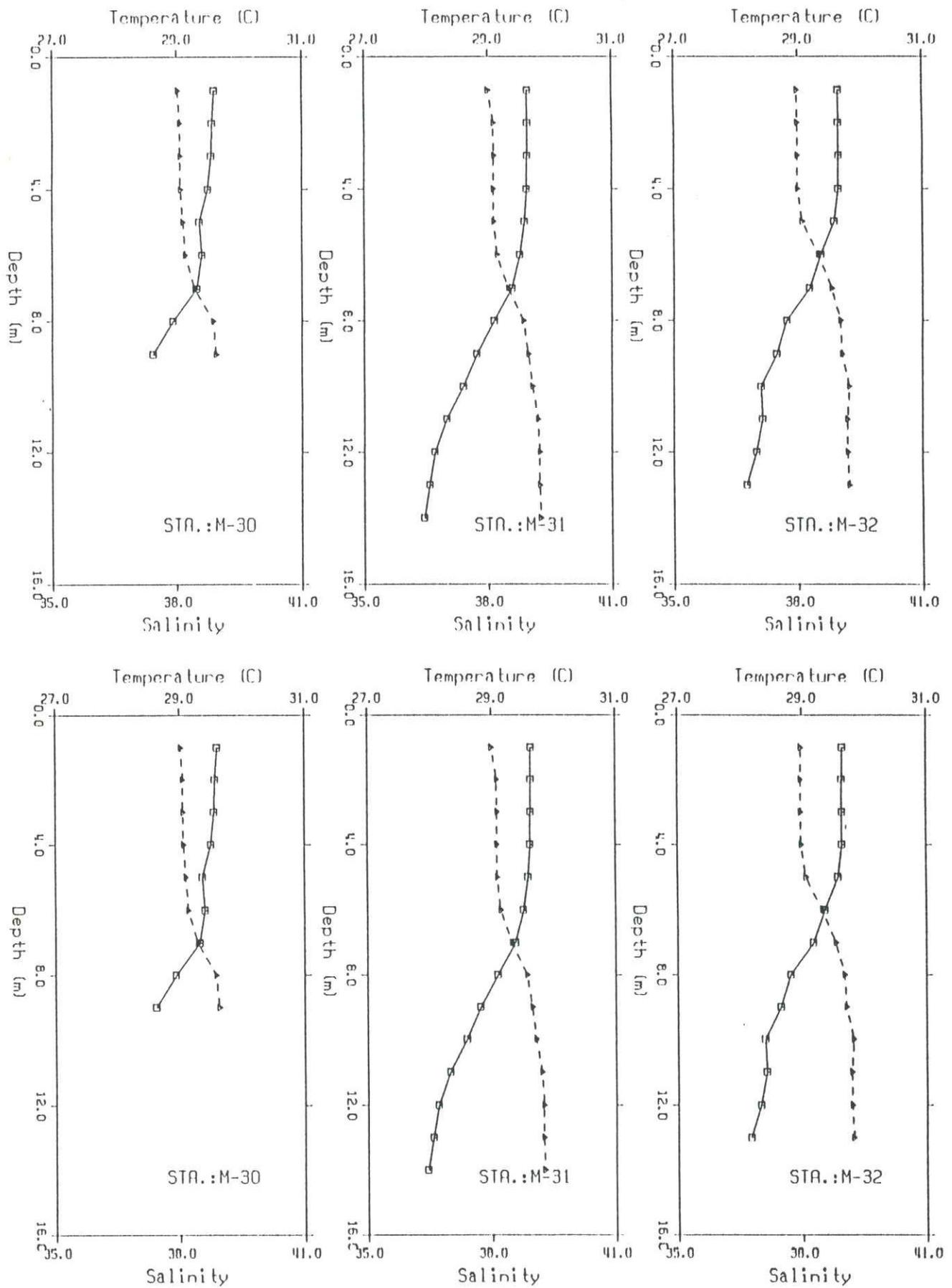


Fig.I.4 Temperature and salinity profiles, Aug 1992

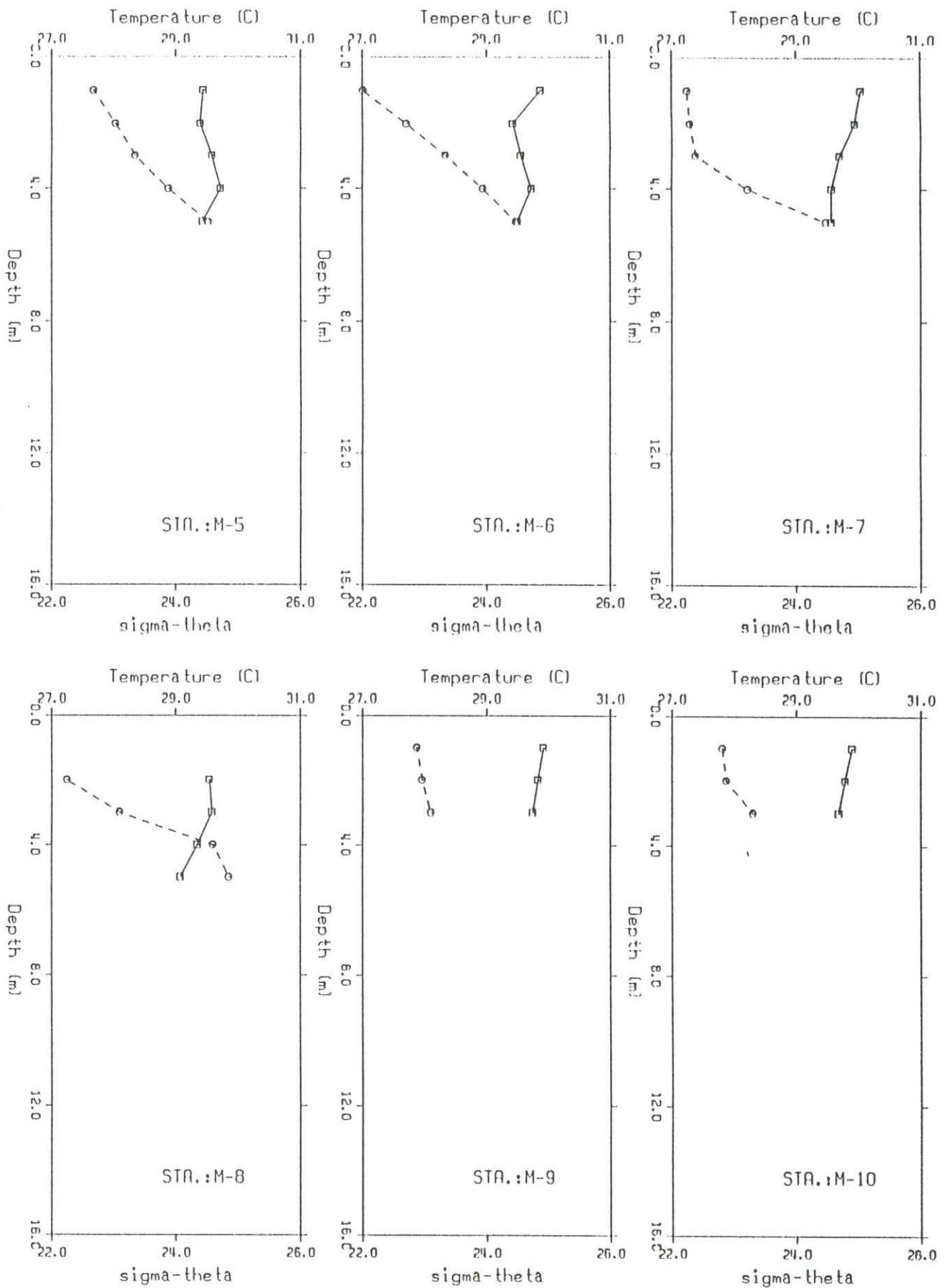


Fig.I.4 Temperature and density profiles, Aug 1992

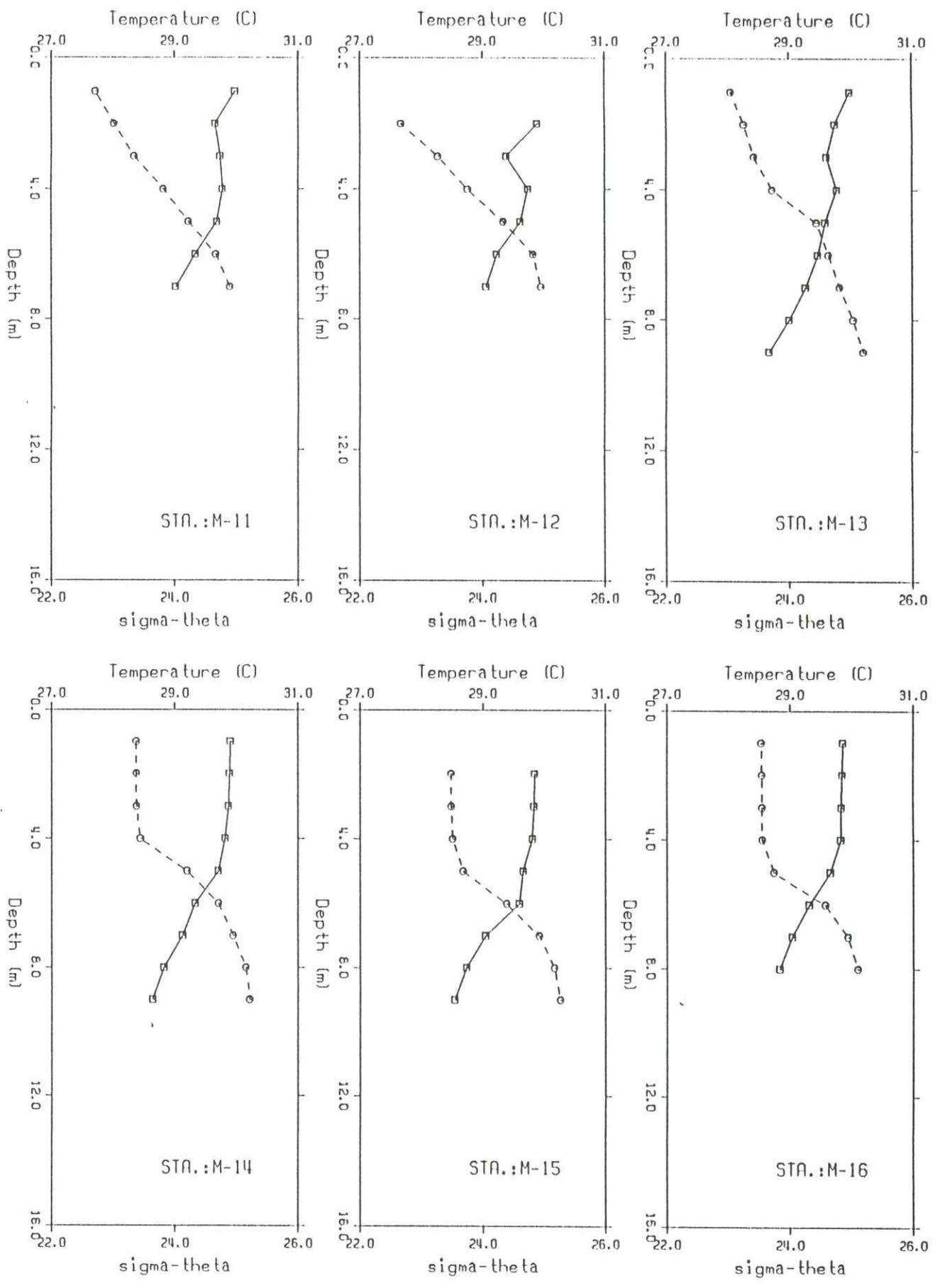


Fig.I.4 Temperature and density profiles, Aug 1992

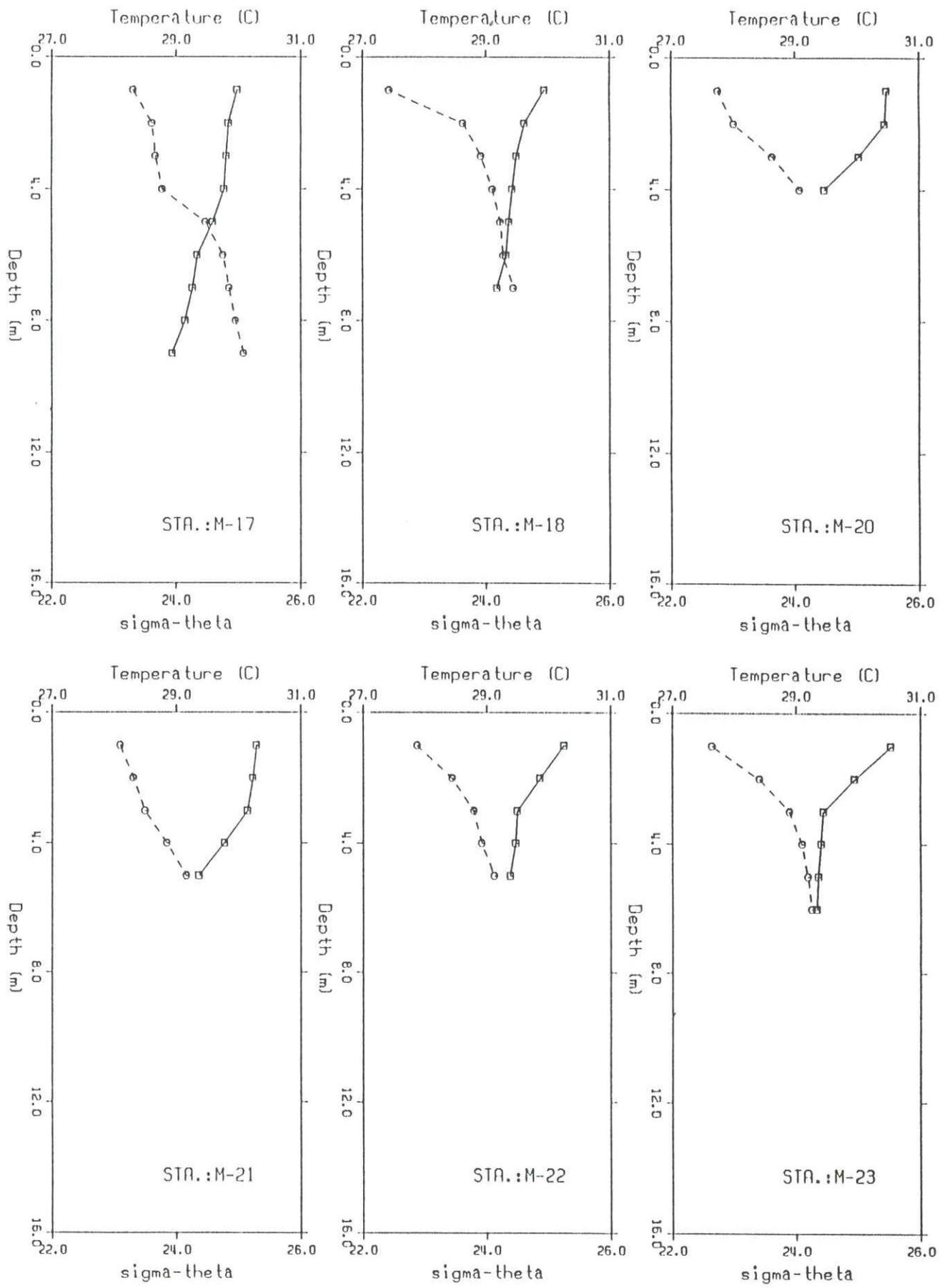


Fig.I.4 Temperature and density profiles, Aug 1992

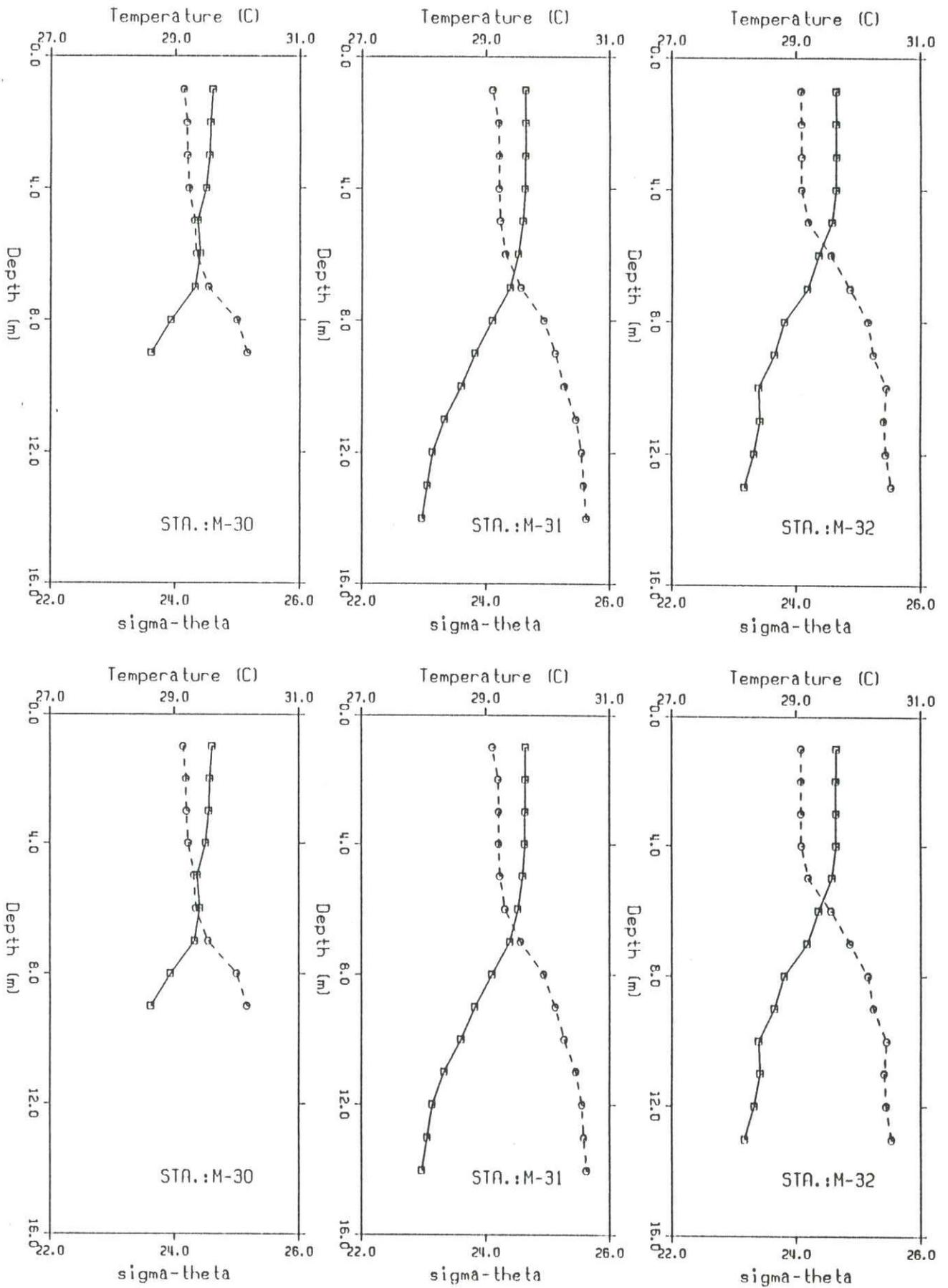


Fig.I.4 Temperature and density profiles, Aug 1992

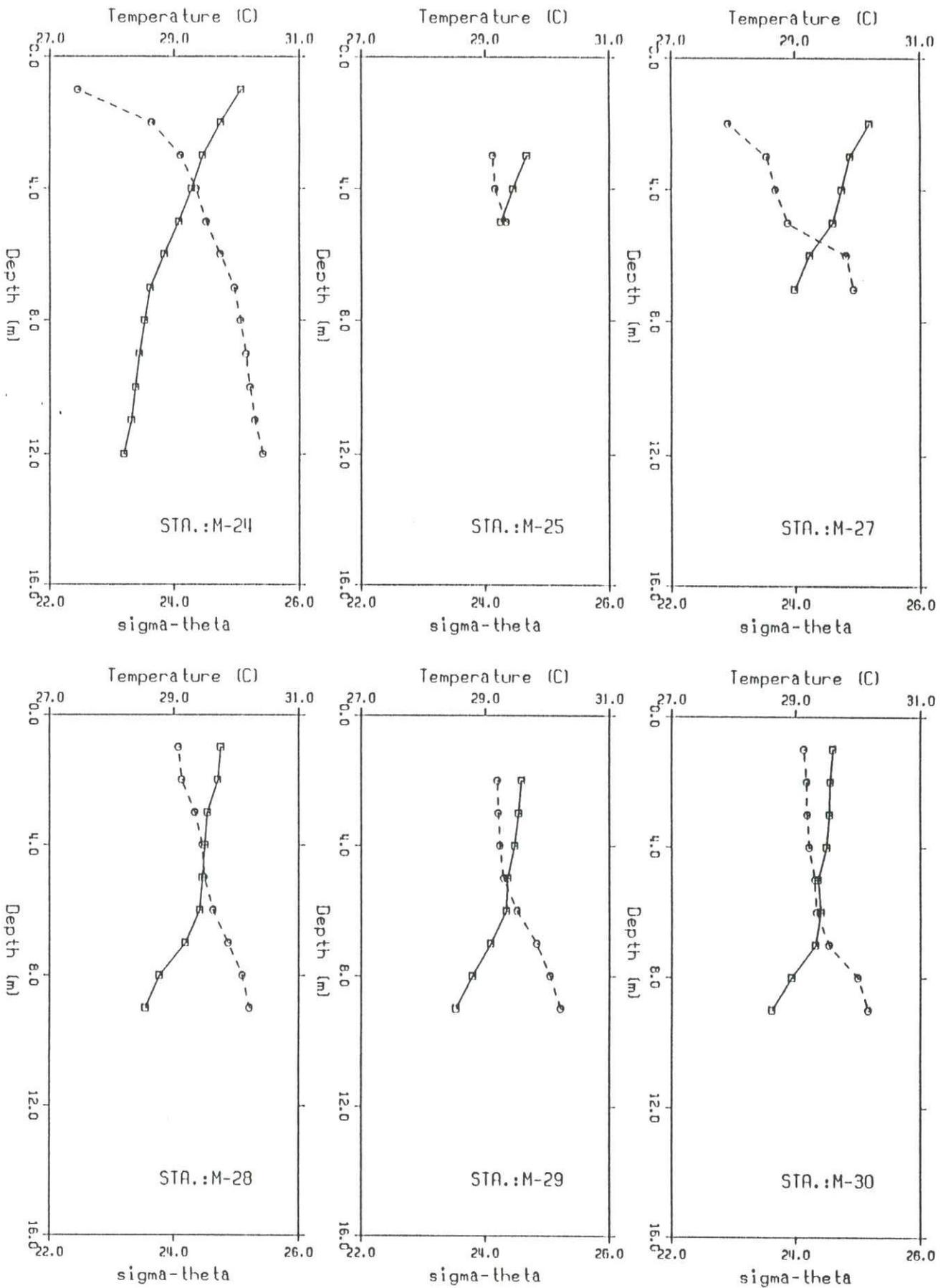


Fig.I.4 Temperature and density profiles, Aug 1992

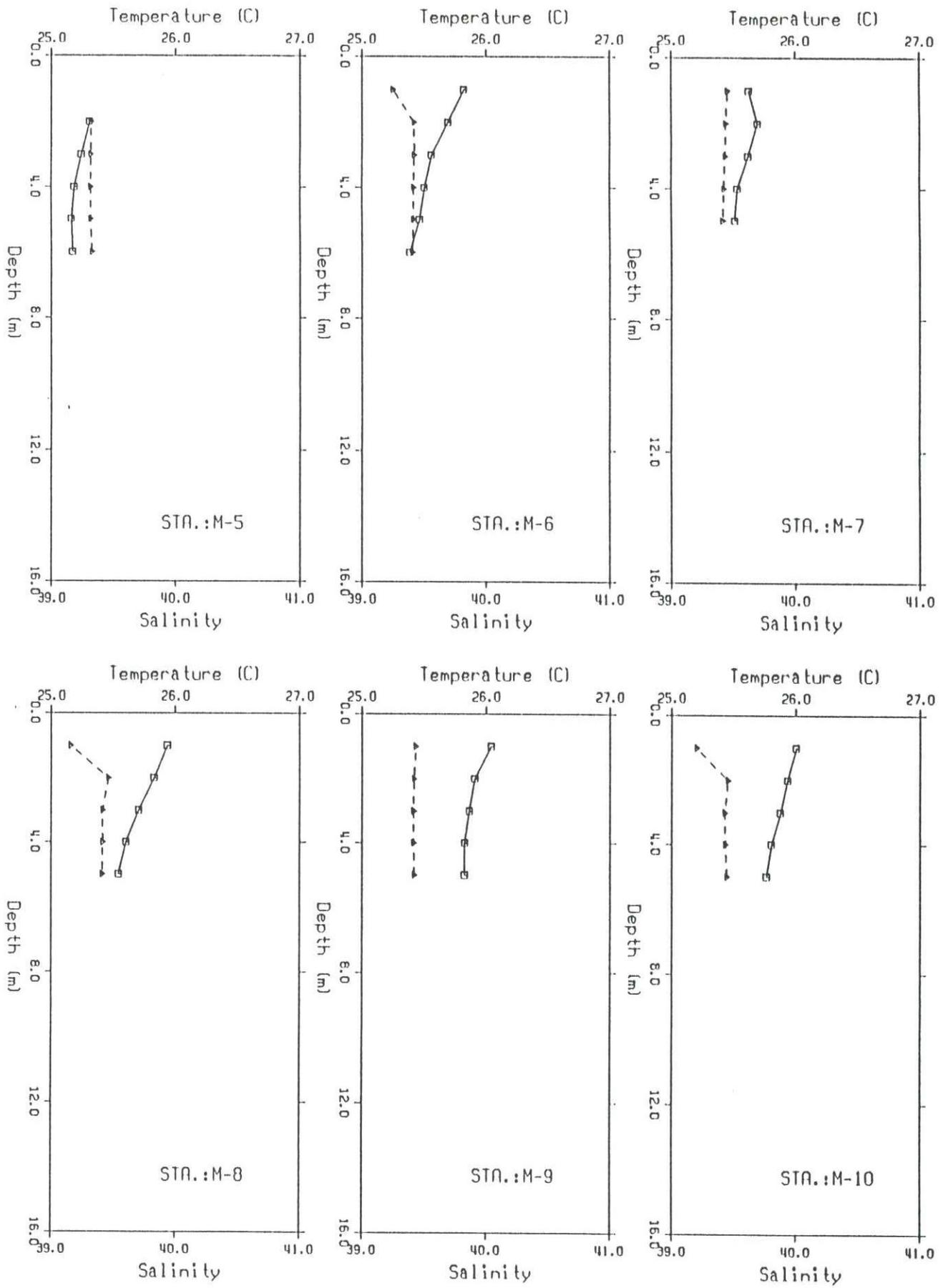


Fig. I.5 Temperature and salinity profiles, Oct 1992

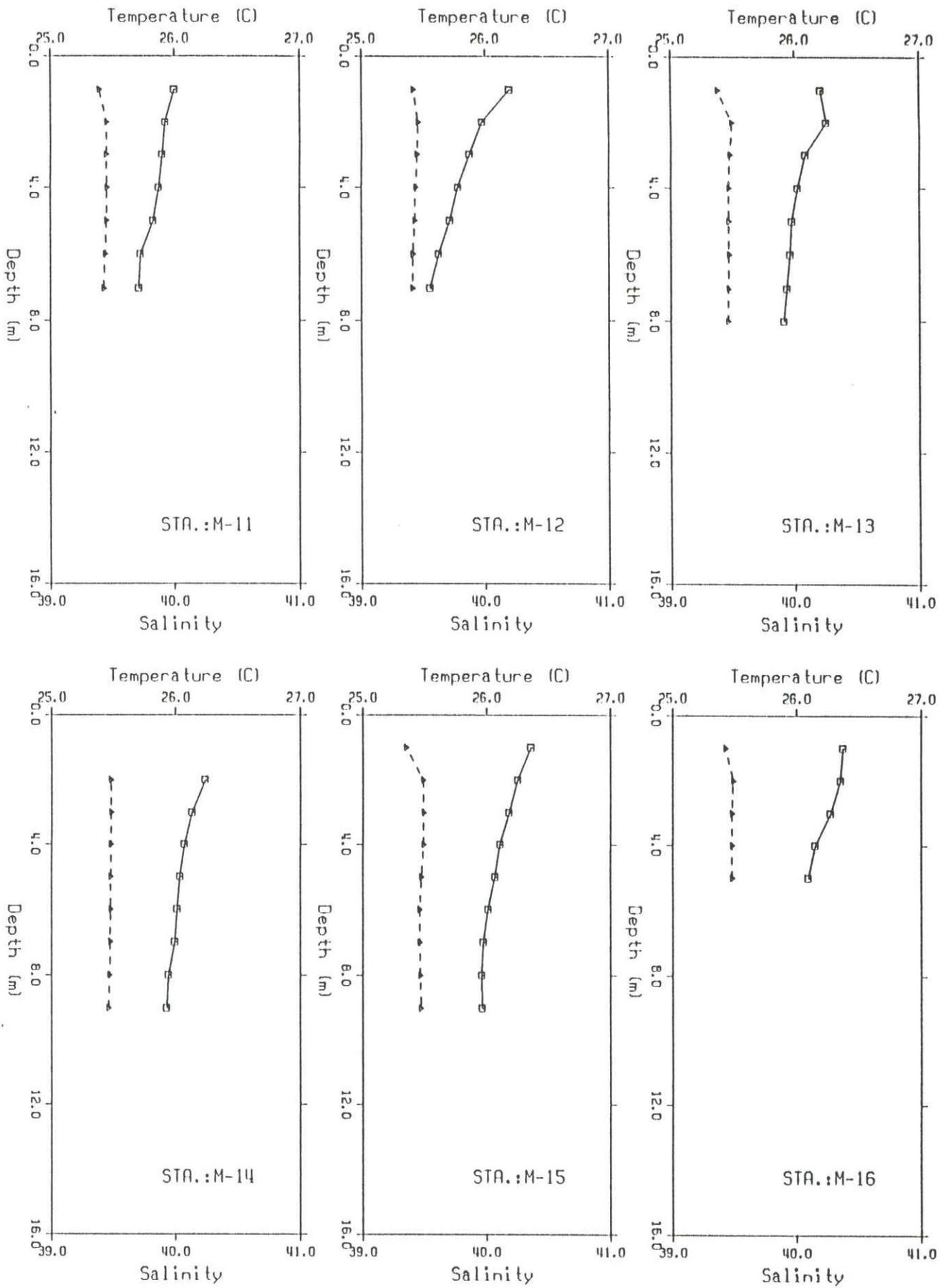


Fig. I.5 Temperature and salinity profiles, Oct 1992

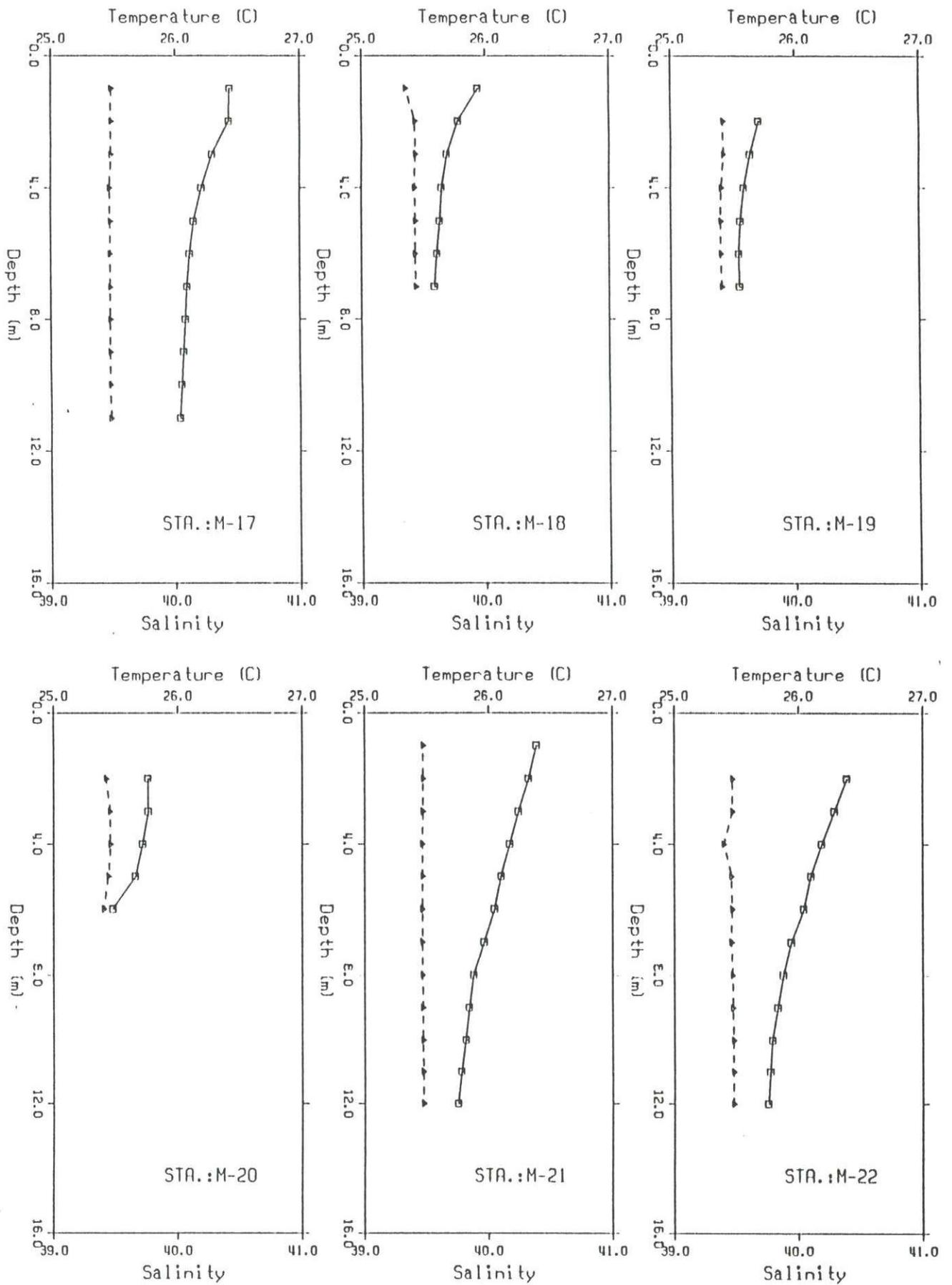


Fig. I.5 Temperature and salinity profiles, Oct 1992

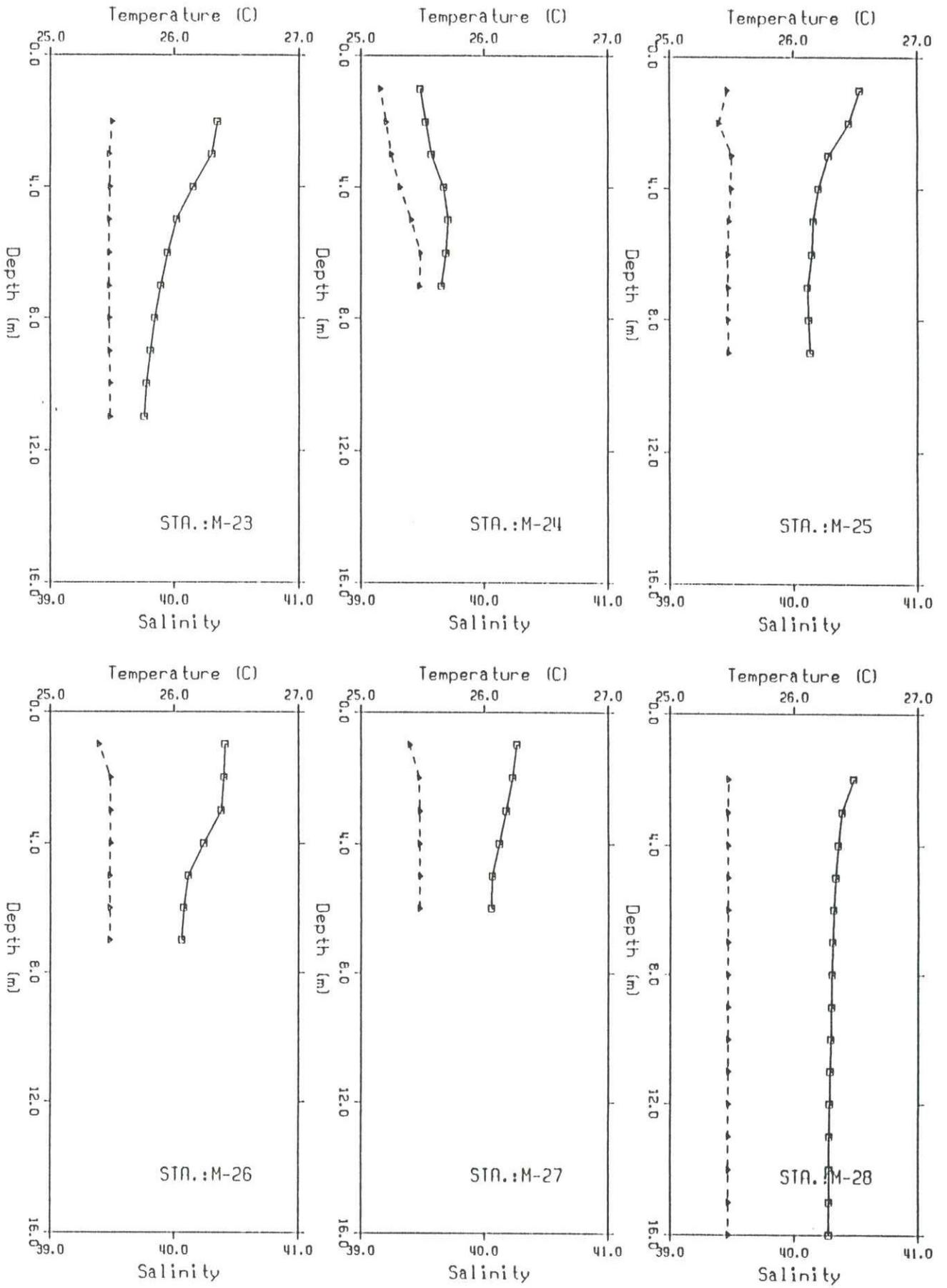


Fig. 1.5 Temperature and salinity profiles, Oct 1992

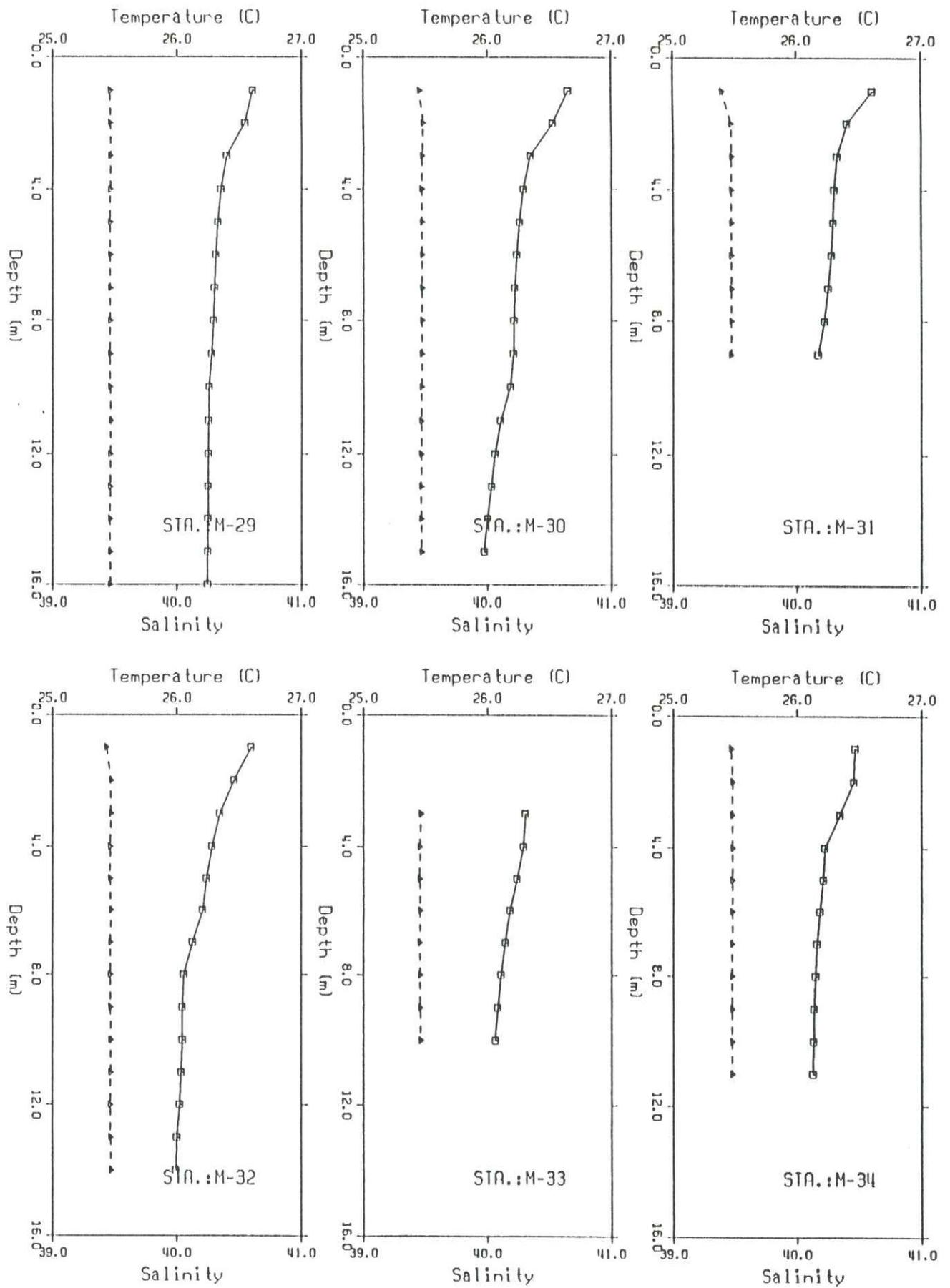


Fig. I.5 Temperature and salinity profiles, Oct 1992

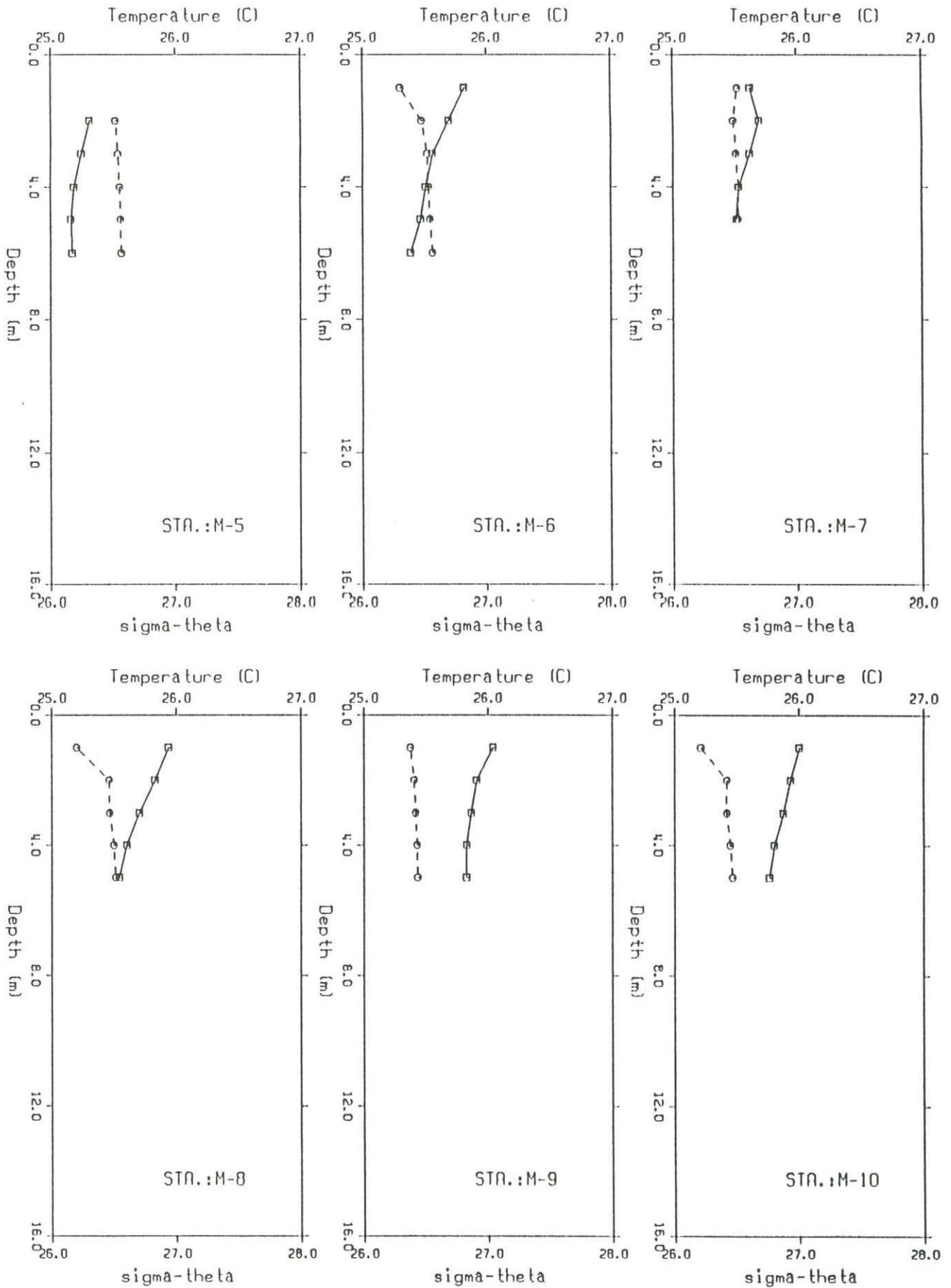


Fig.I.5 Temperature and density profiles, Oct 1992

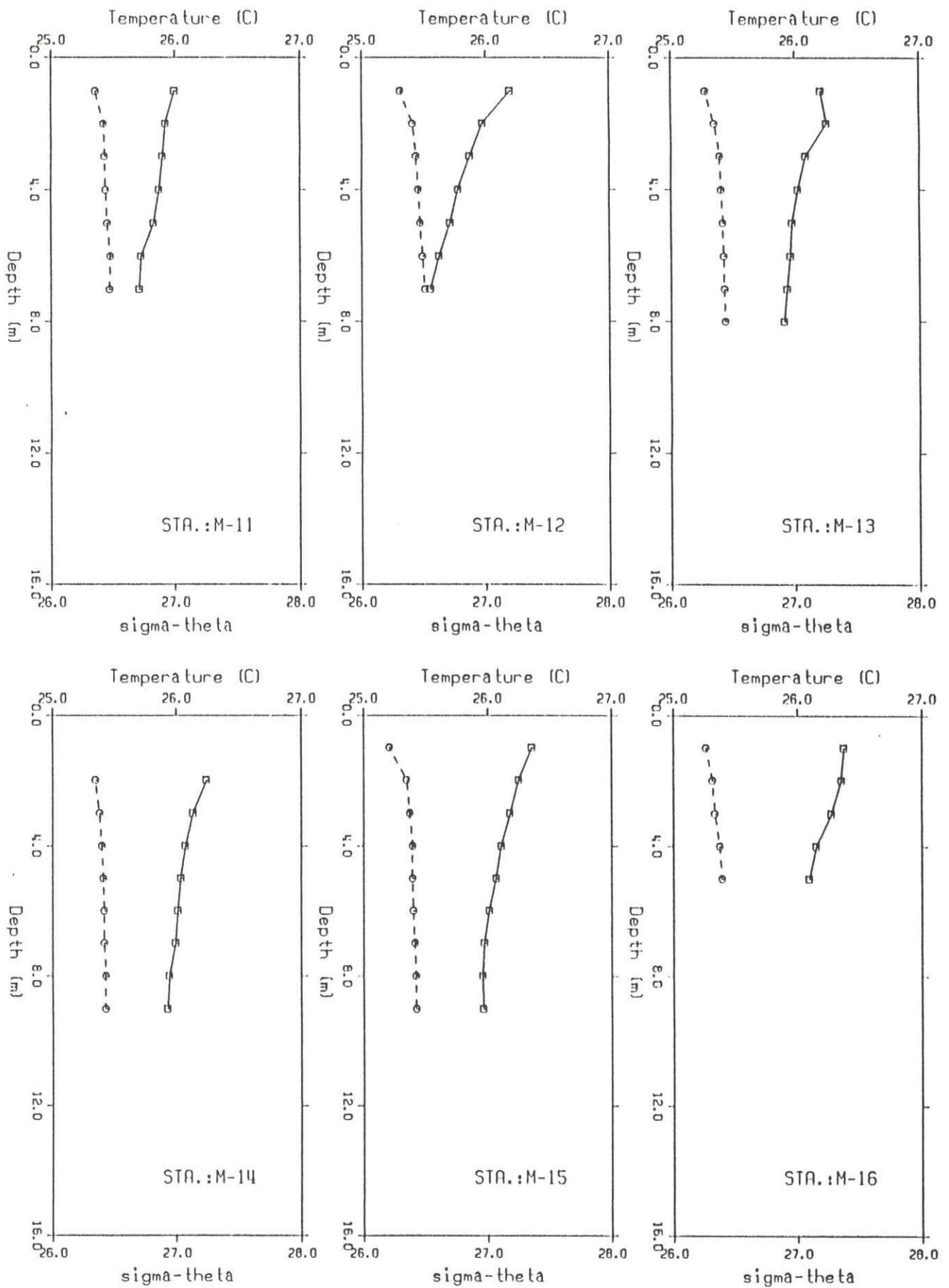


Fig. I.5 Temperature and density profiles, Oct 1992

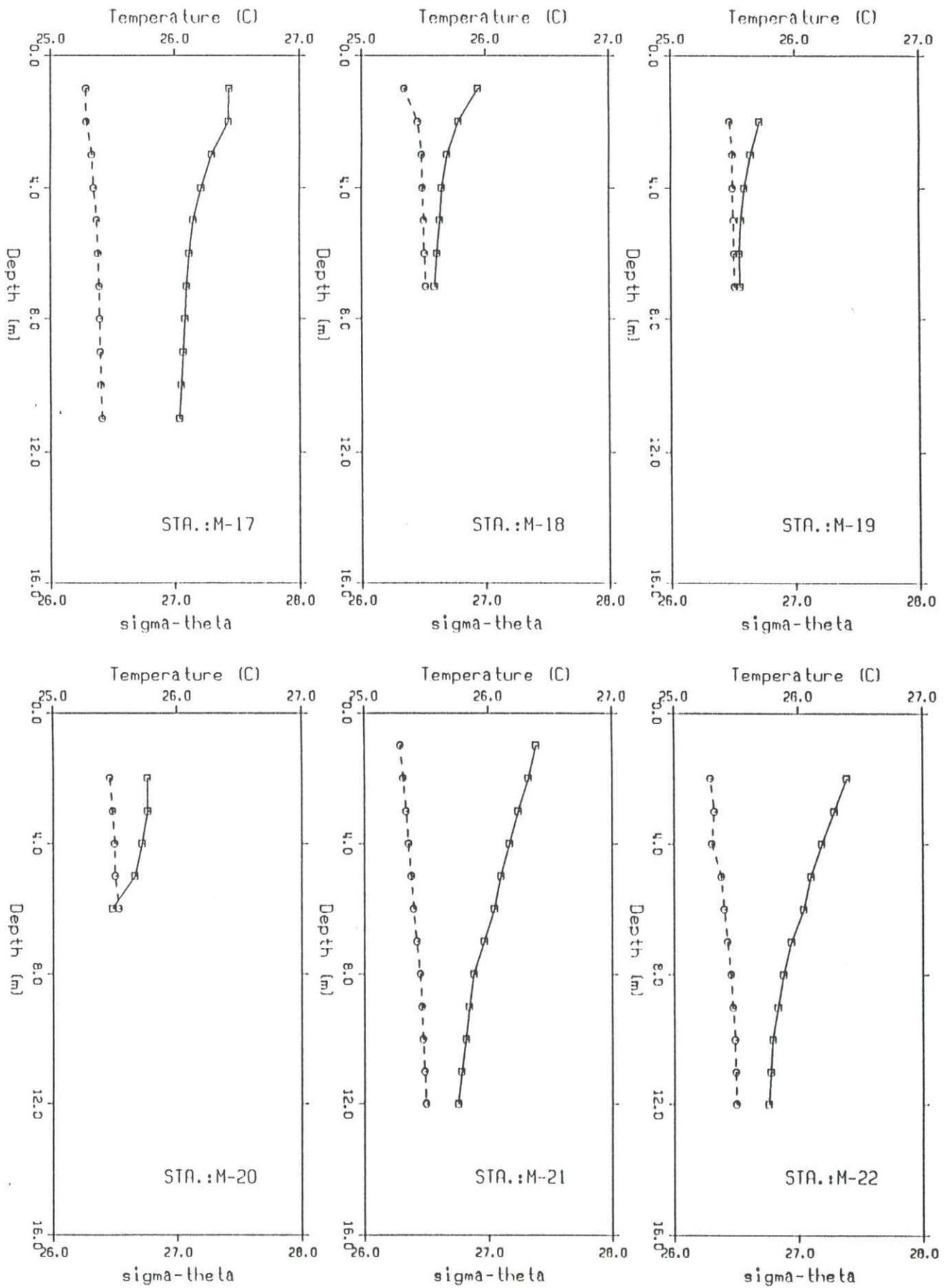


Fig.I.5 Temperature and density profiles, Oct 1992

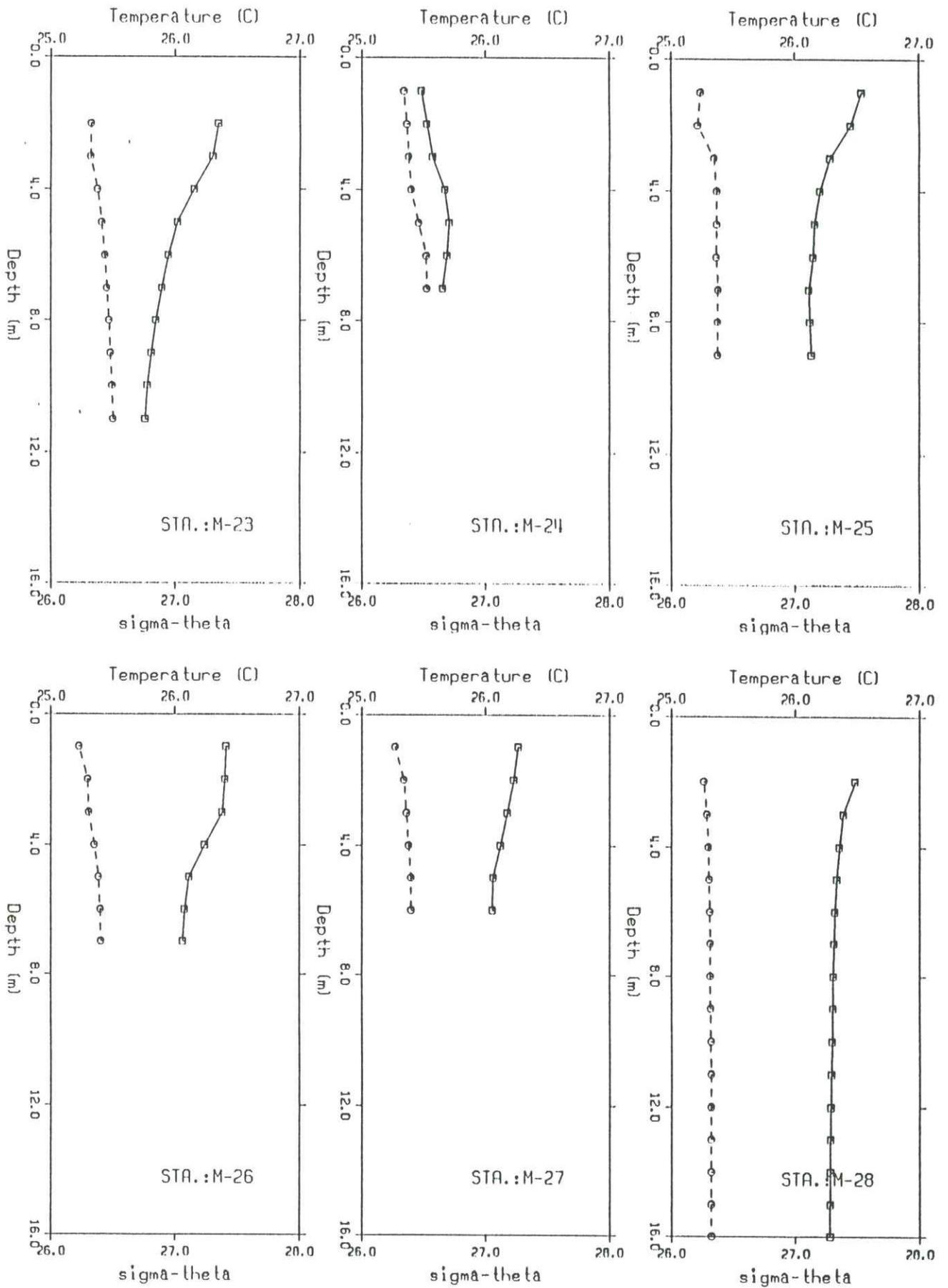


Fig.I.5 Temperature and density profiles, Oct 1992

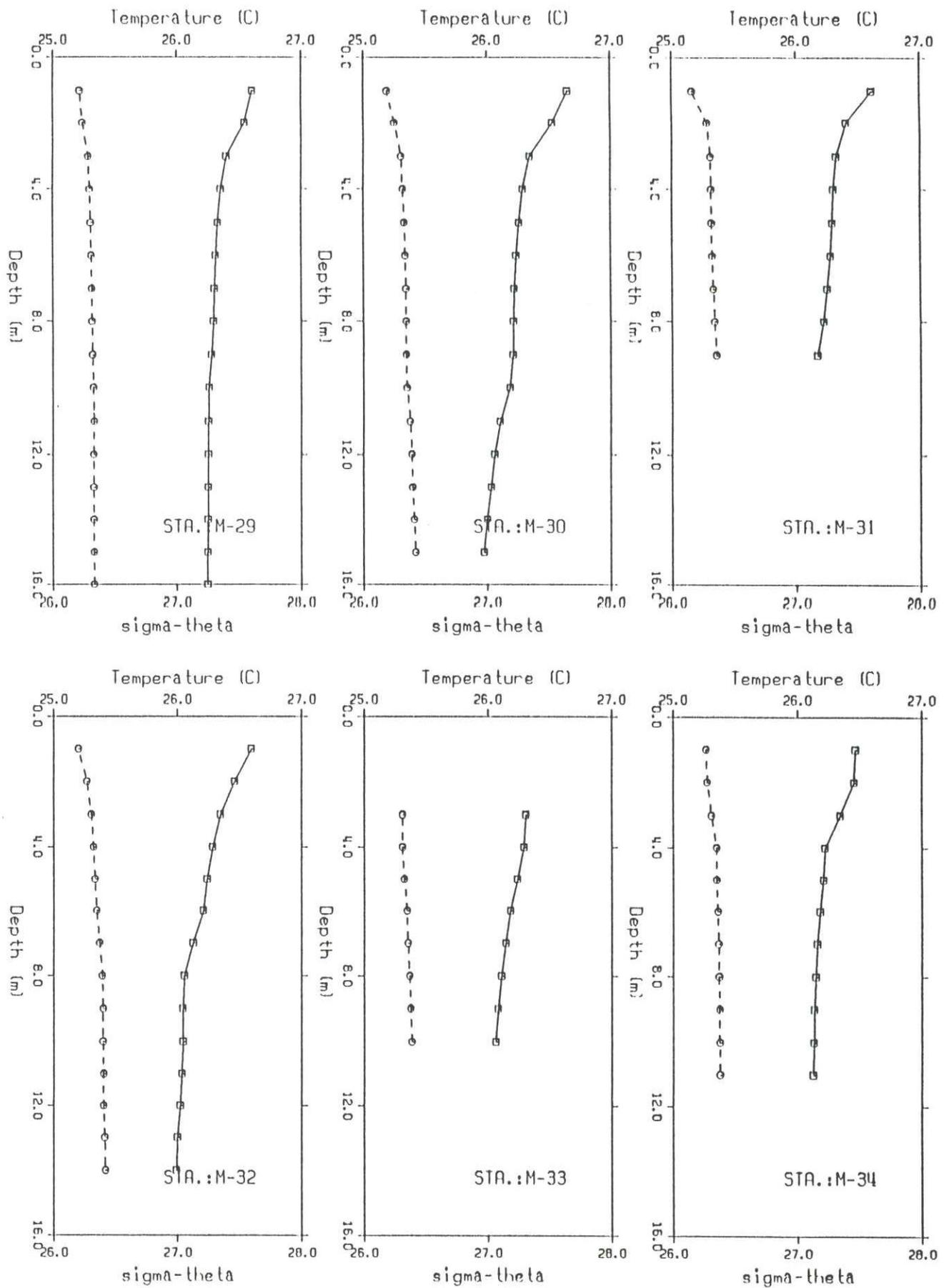


Fig.I.5 Temperature and density profiles, Oct 1992

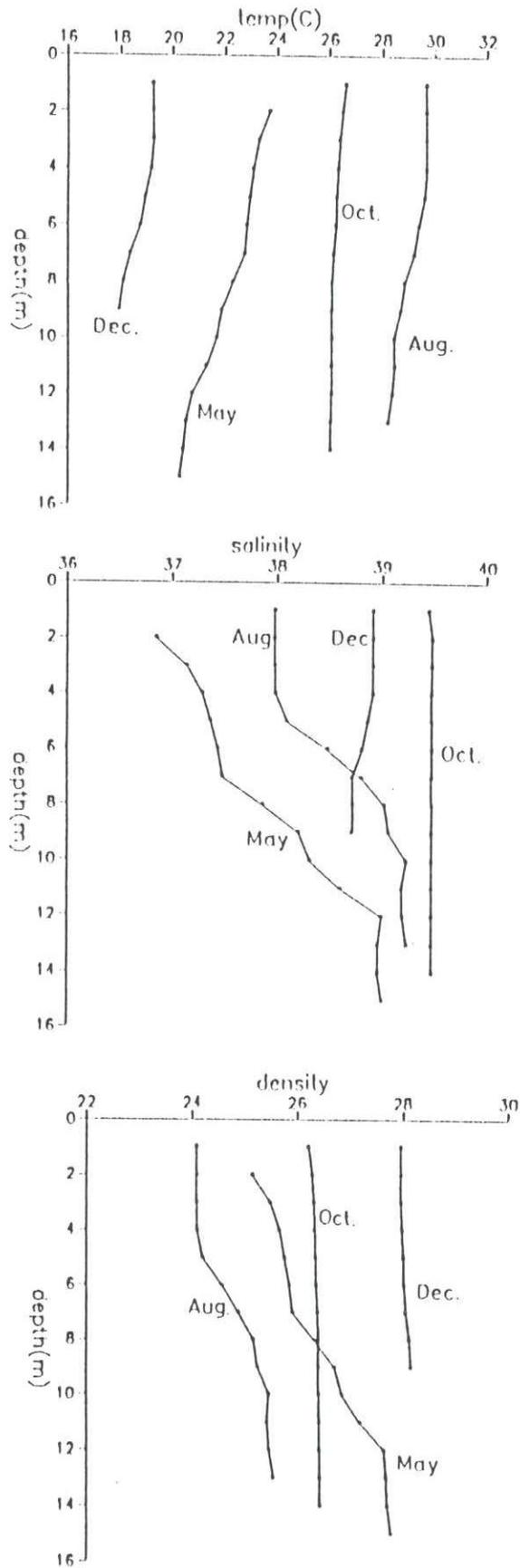


Fig.I.6 Property profiles for the four cruises at M-32.

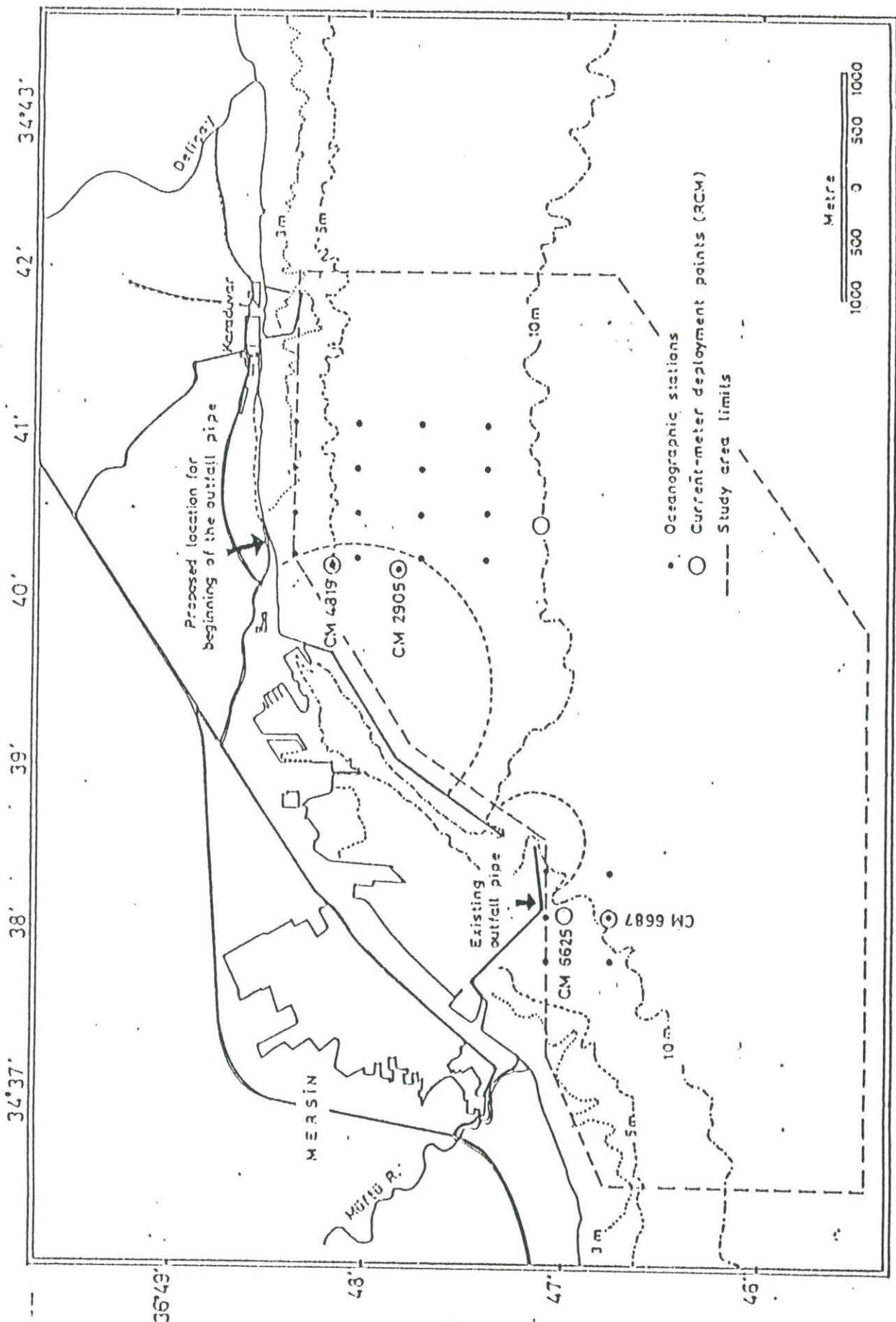


Fig.I.7 Current meter stations, April-May 1992

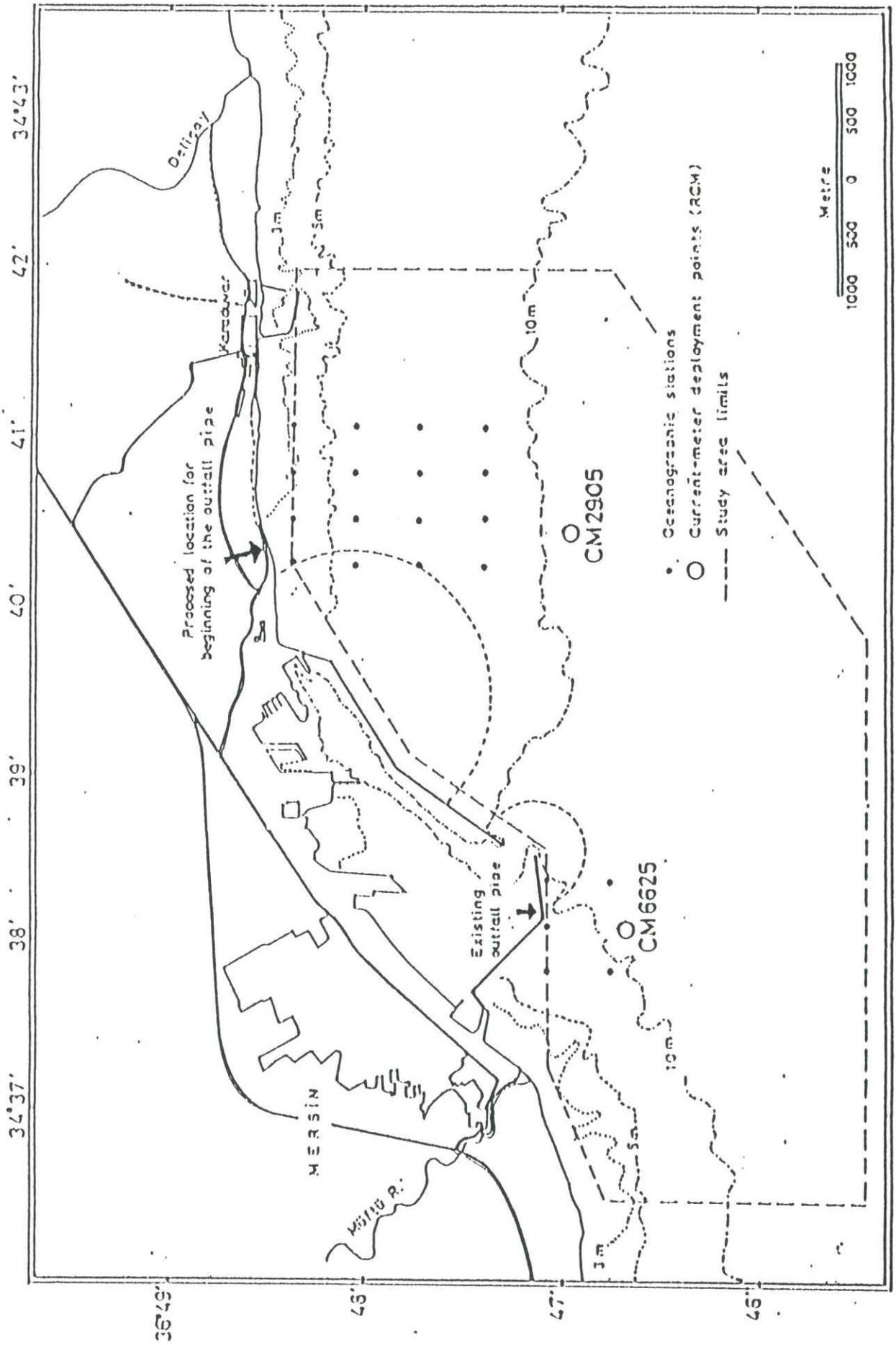


Fig.I.8 Current meter stations, July-August 1992

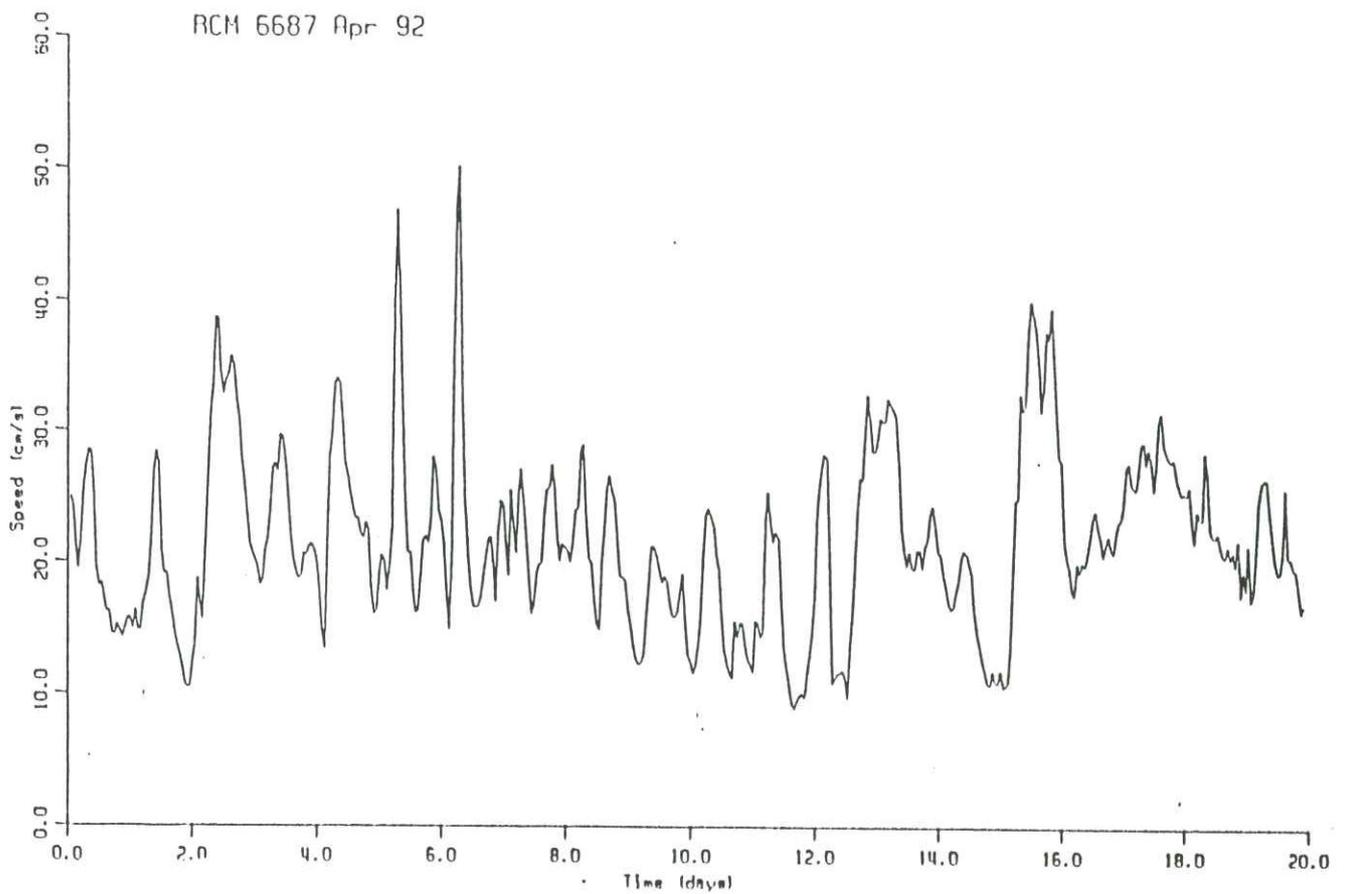
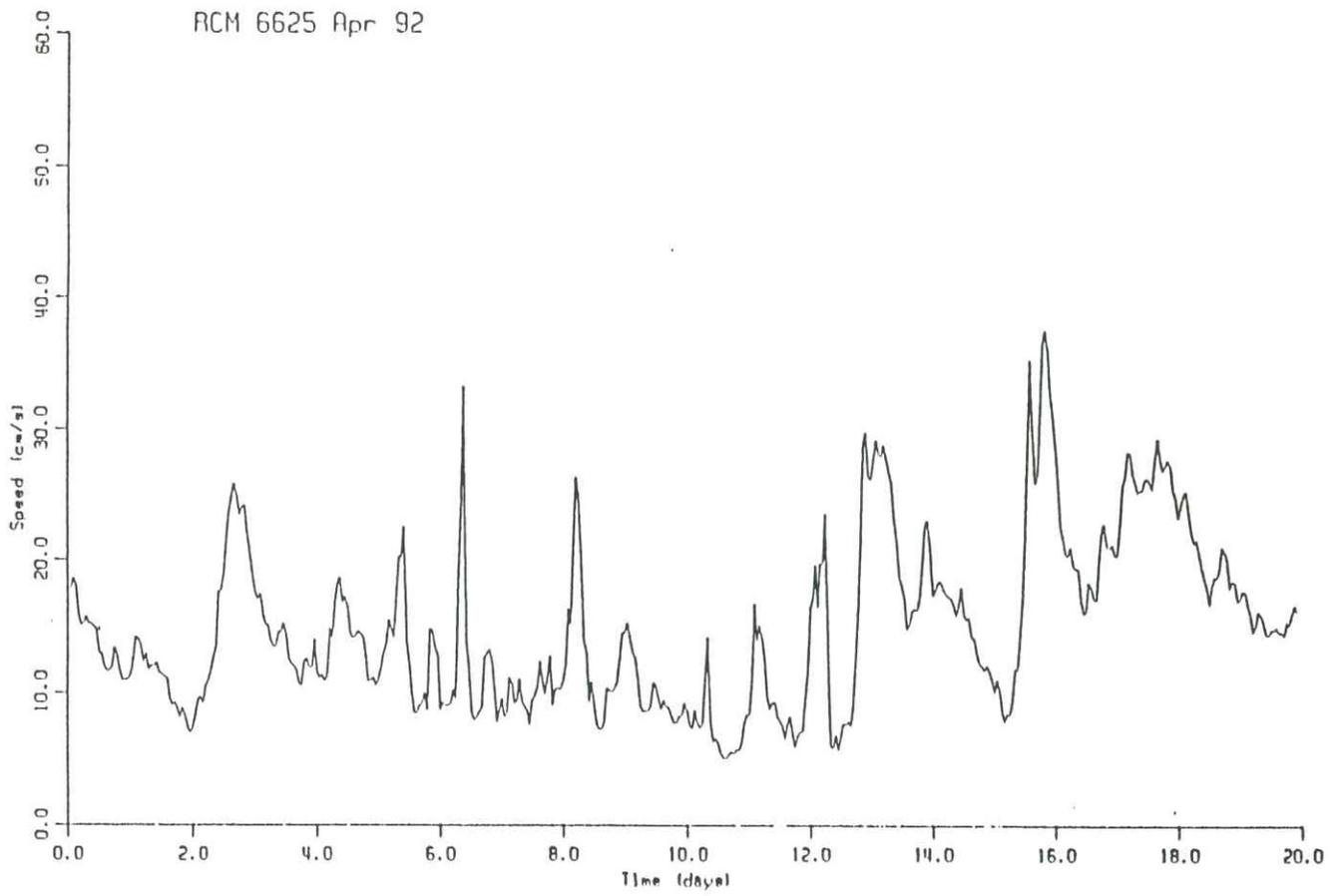


Fig.I.9 Current speed time series April-May 1992

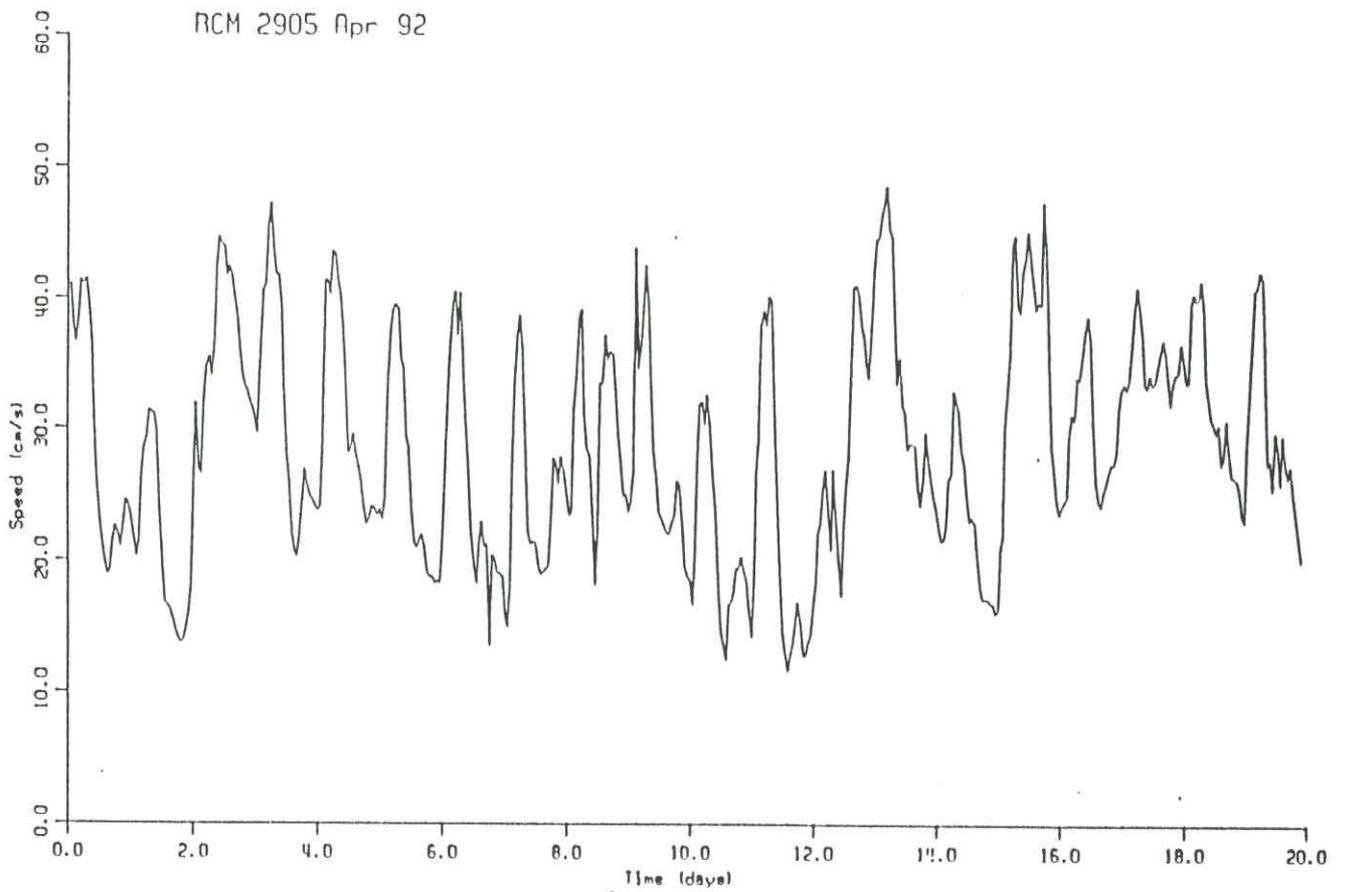
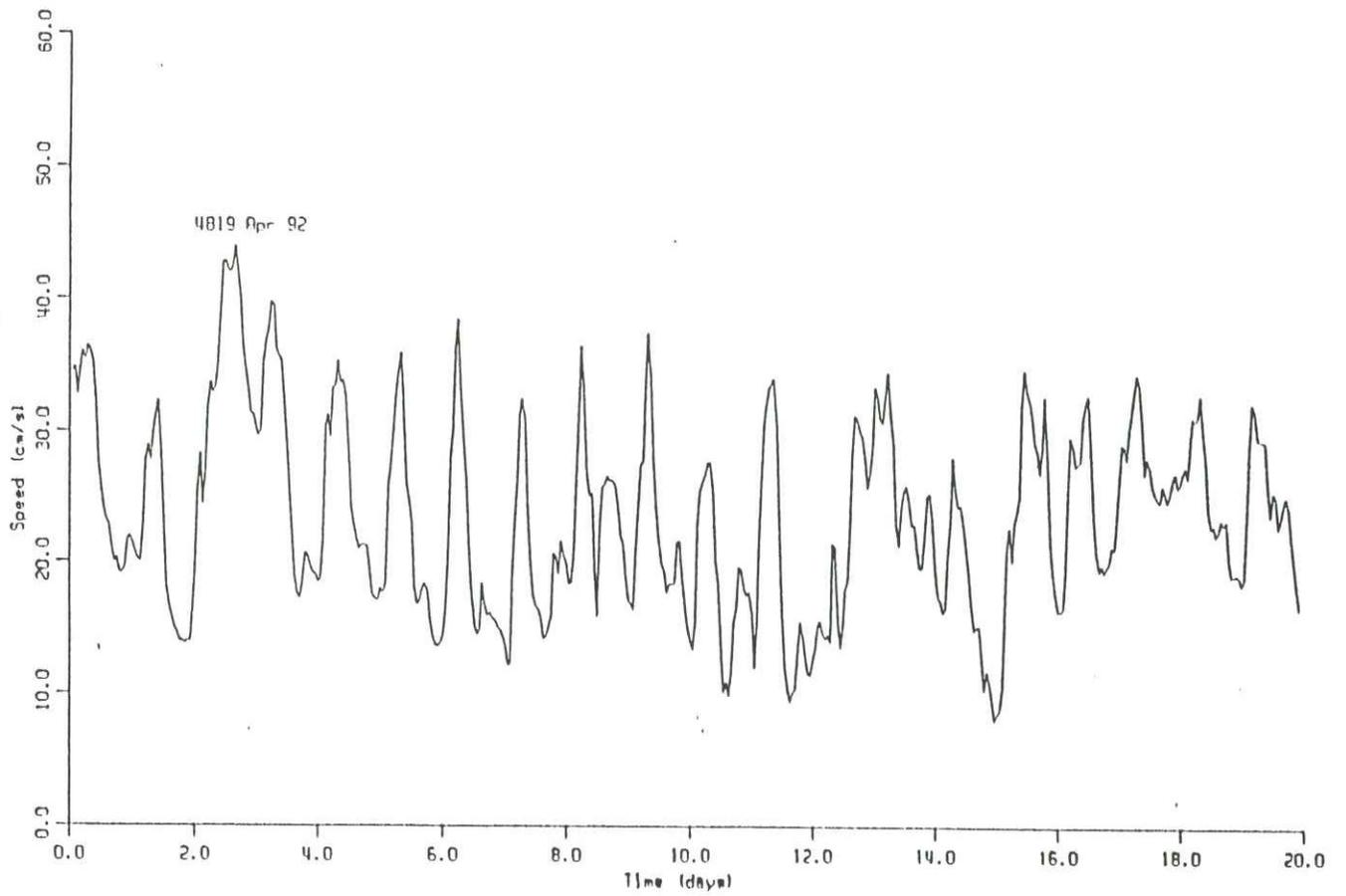


Fig.I.10 Current speed time series April-May 1992

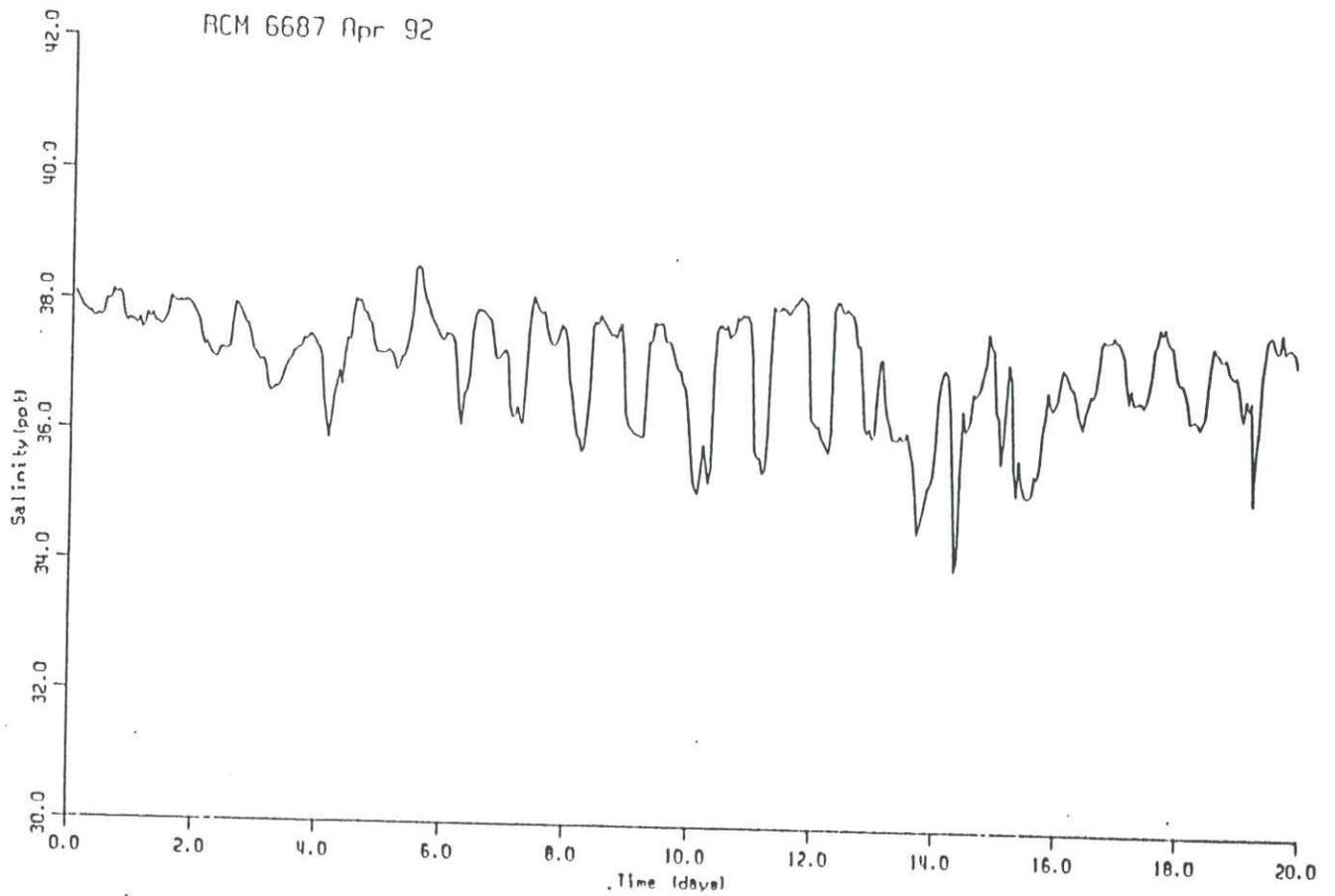
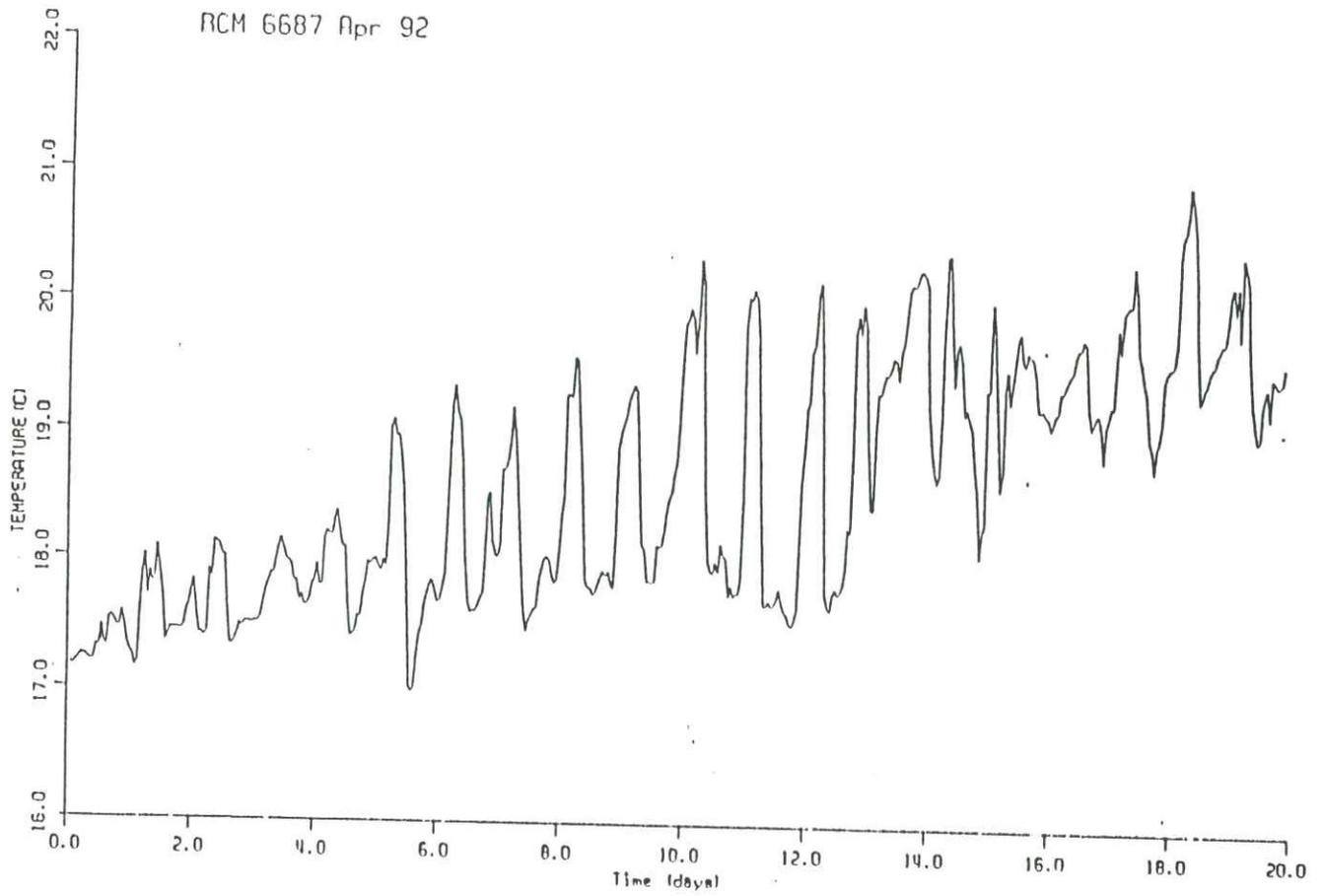


Fig.I.11 Temp. and salinity time series at CM 6687 Apr-May 1992

RCM 6625 22.4-12.5.1992

current velocity vector

vel scale: 1 cm = 20. cm/s.



1. +
2. +
3. +
4. +
5. +
6. +
7. +
8. +
9. +
10. +



11. +
12. +
13. +
14. +
15. +
16. +
17. +
18. +
19. +
Days

Fig. I.12 Current velocity vector April-May 1992

current velocity vector RCM 6687 22.4-12.5.1992

vel scale: 1 cm = 20. cm/s.

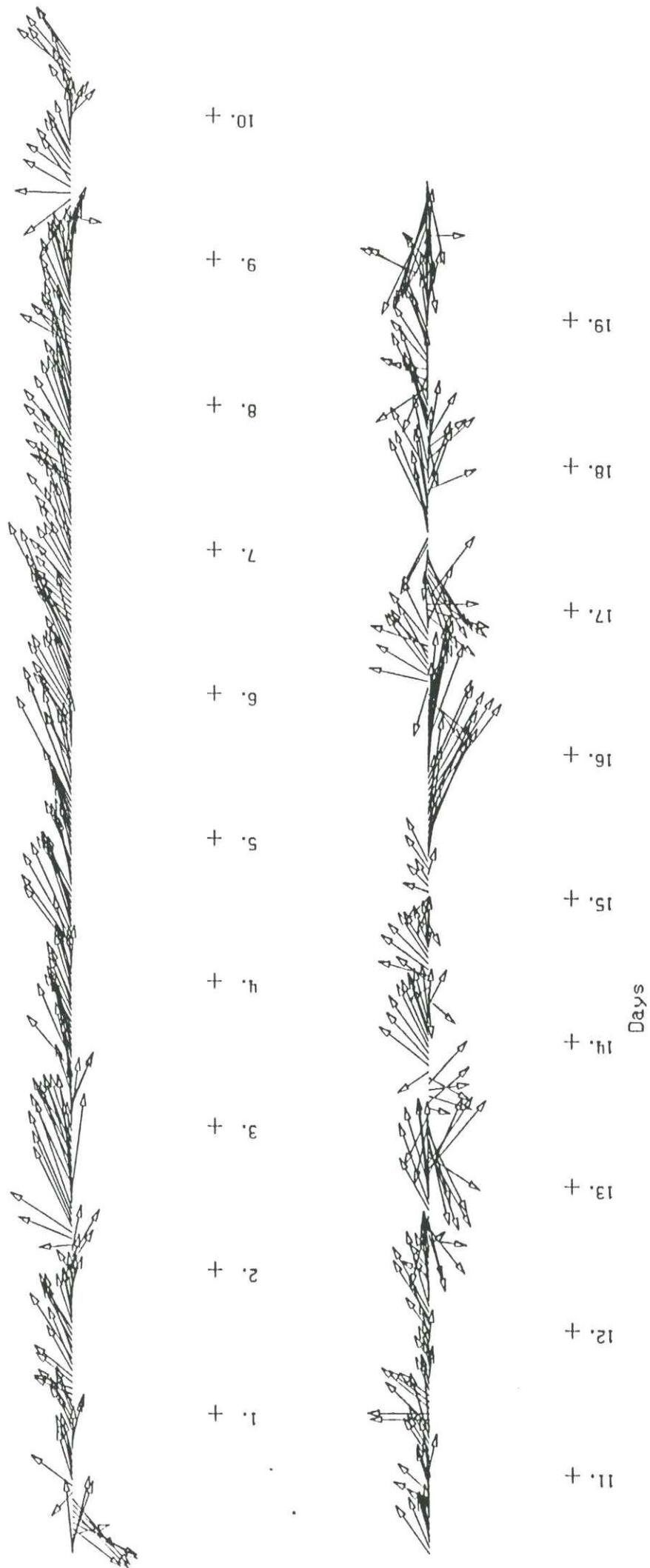


Fig. I.13 Current velocity vector April-May 1992

current velocity vector RCM 4819 4819 22.4-12.5.1992

vel scale: 1 cm = 20. cm/s.

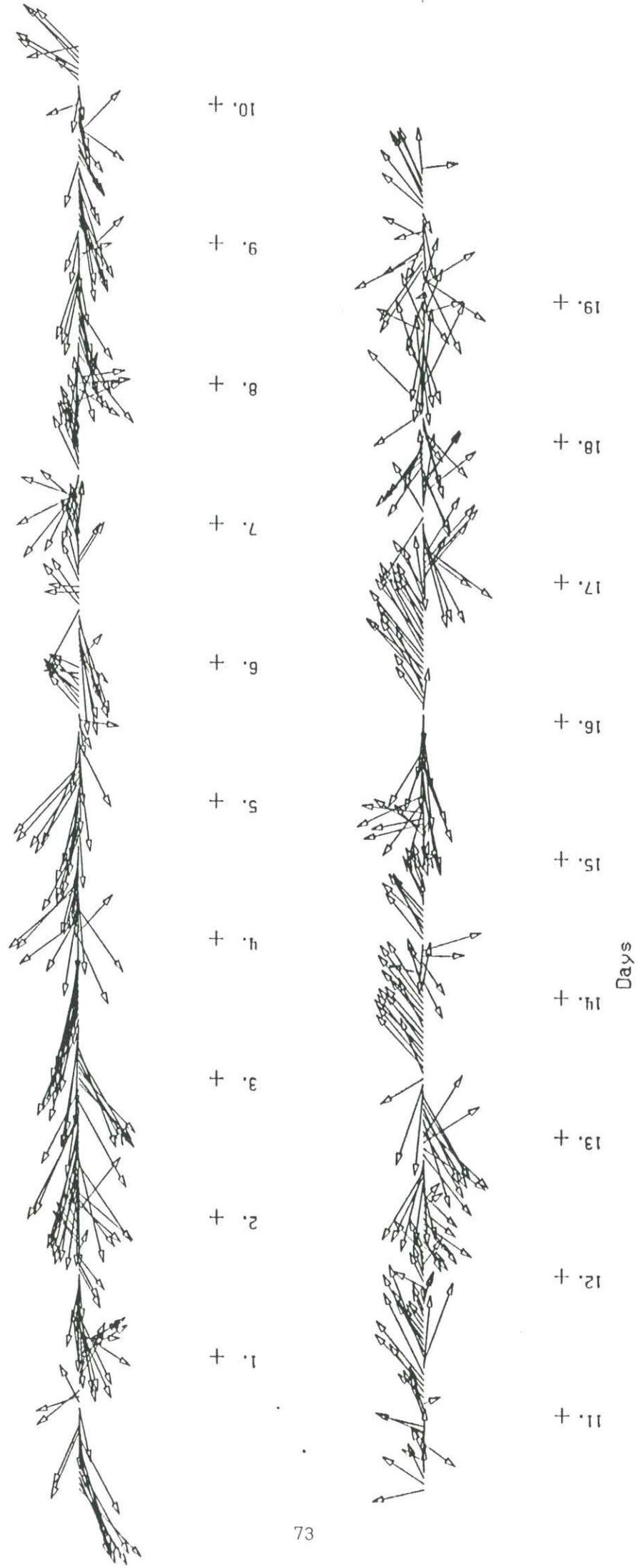


Fig.I.14 Current velocity vector April-May 1992

current velocity vector RCM 2905 22.4-12.5.1992

vel scale: 1 cm = 20. cm/s.

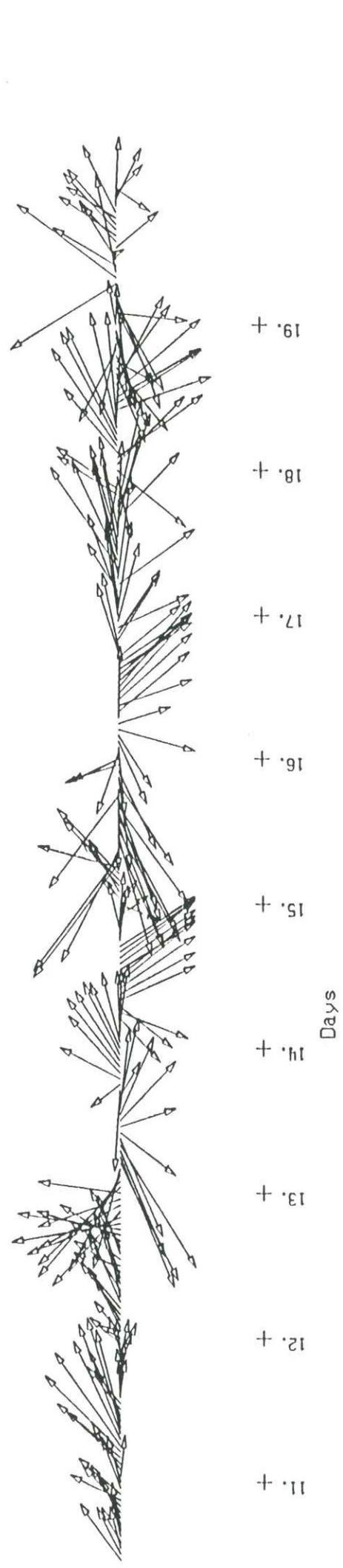
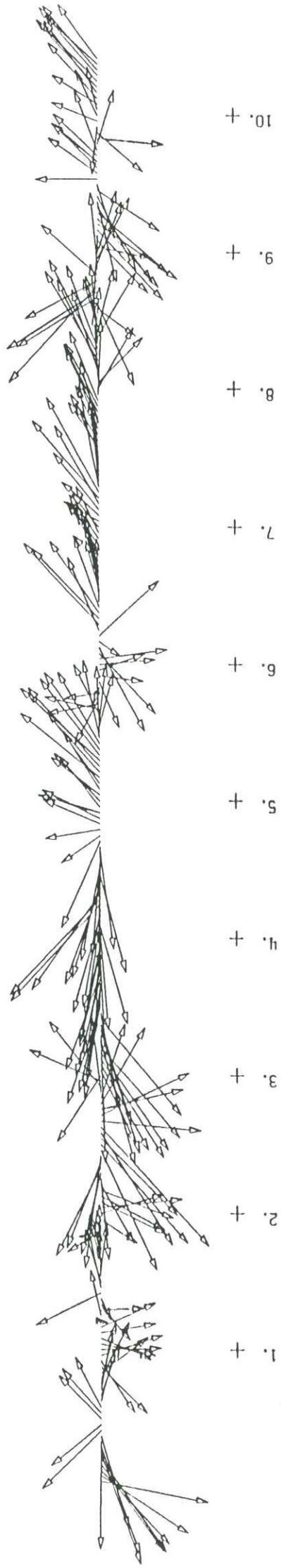


Fig.I.15 Current velocity vector April-May 1992

CM 6625 Apr 92
Progressive vel vector plot (vel scale: 1cm=150 cm/s.)

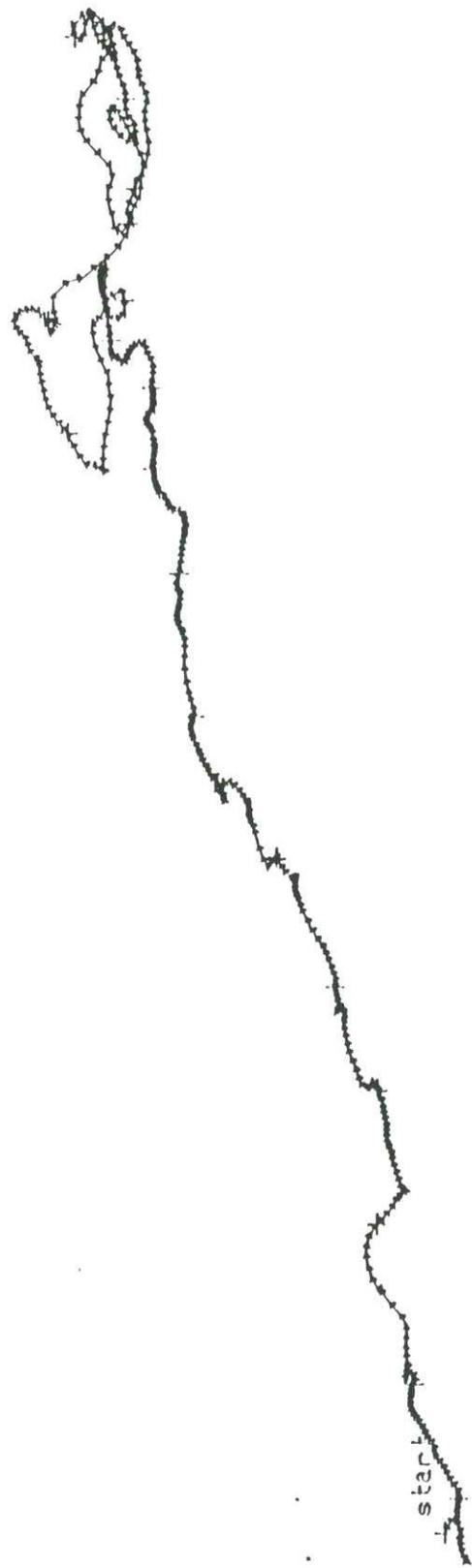


Fig. I.16 Progressive vector diagram CM 6625 Apr-May 1992

CM 6687 Apr 92
Progressive vel vector plot (vel scale: 1cm=[50 cm/s.]

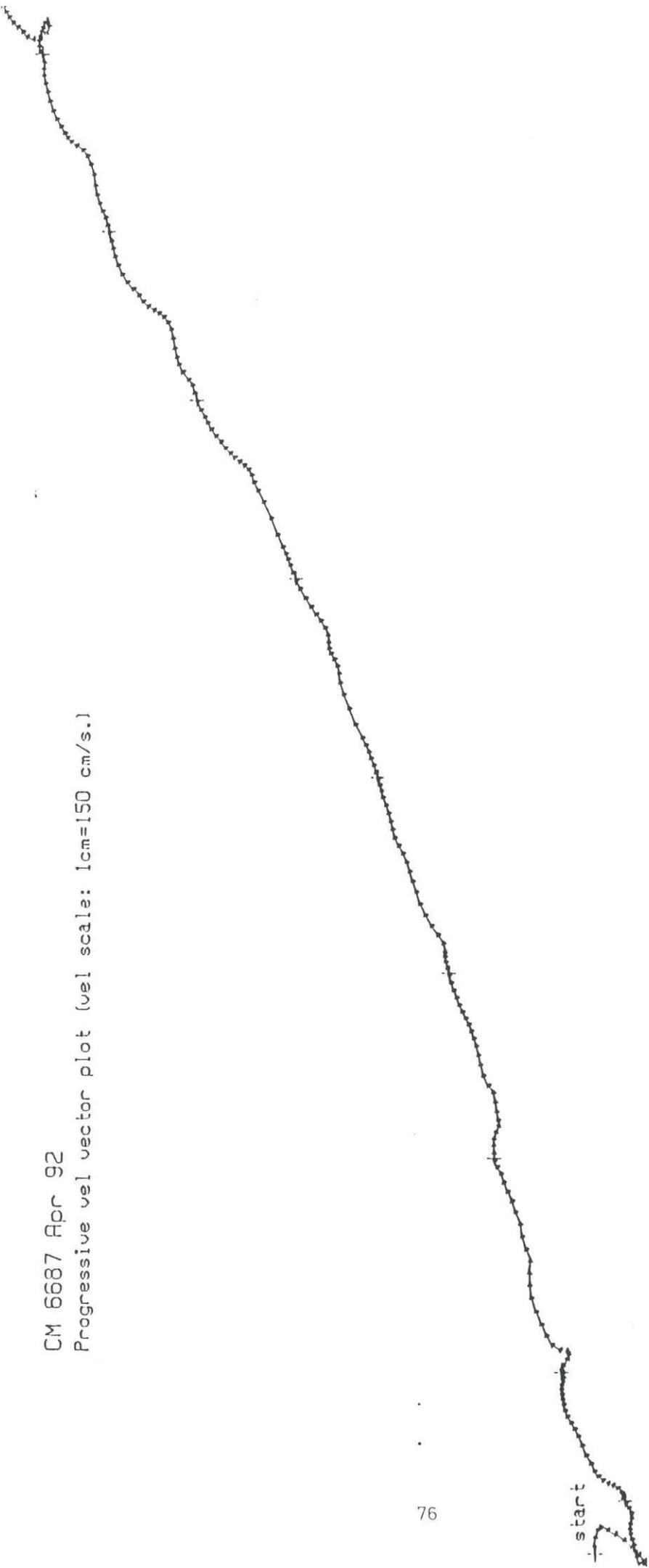


Fig.I.17 Progressive vector diagram CM 6687 Apr-May 1992

CM 4819 Apr 92

Progressive vel vector plot (vel scale: 1cm=150 cm/s.)



Fig.I.18 Progressive vector diagram CM 4819 Apr-May 1992

CM 2905 Apr 92

Progressive vel vector plot (vel scale: 1cm=150 cm/s.)

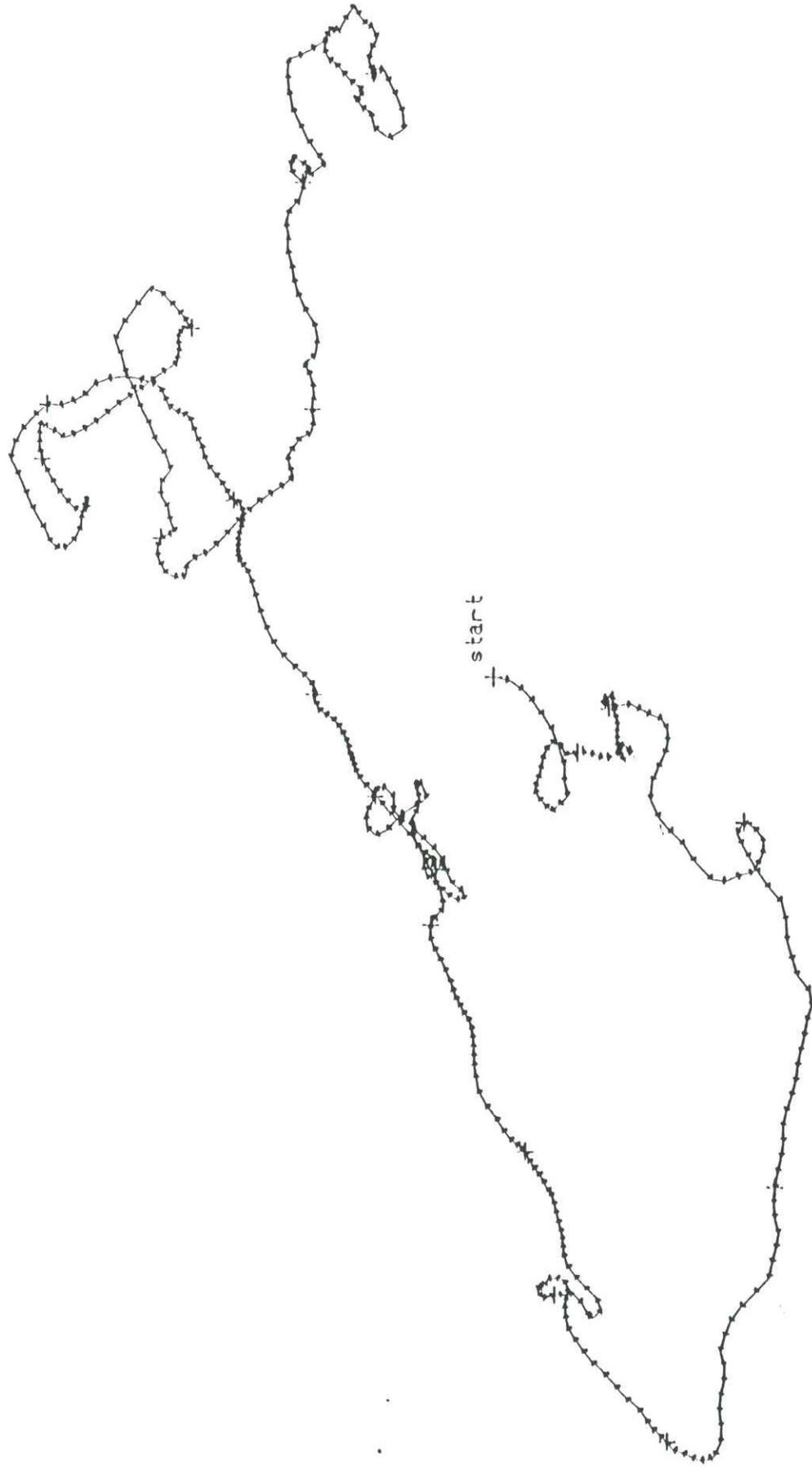
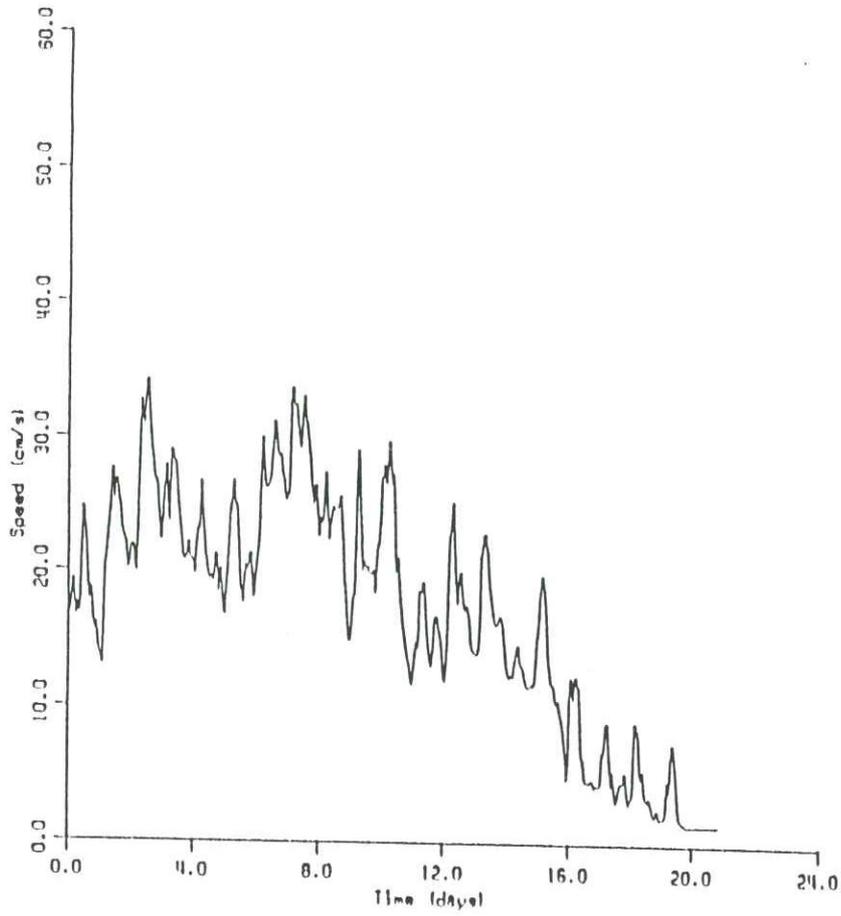


Fig.I.19 Progressive vector diagram CM 2905 Apr-May 1992

RCH 6625 July 92



RCH 2905 July 92

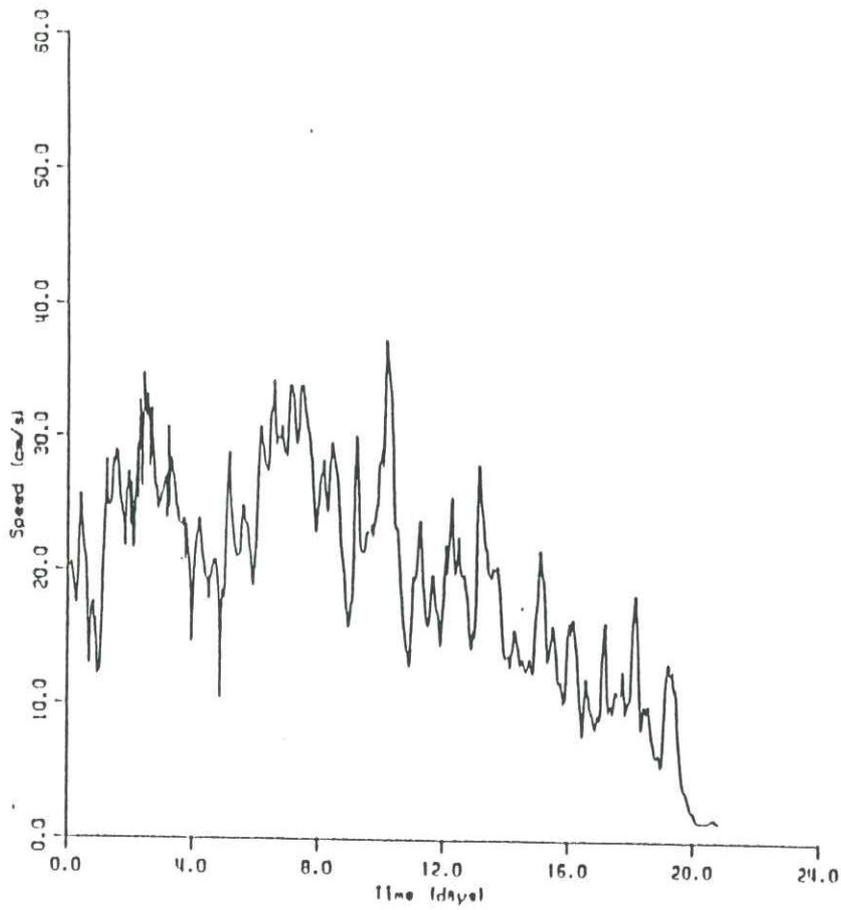


Fig.I.20 Current speed time series Jul-Aug 1992

current velocity vector RCM 6625 22.7-11.8.1992

vel scale: 1 cm = 20. cm/s.

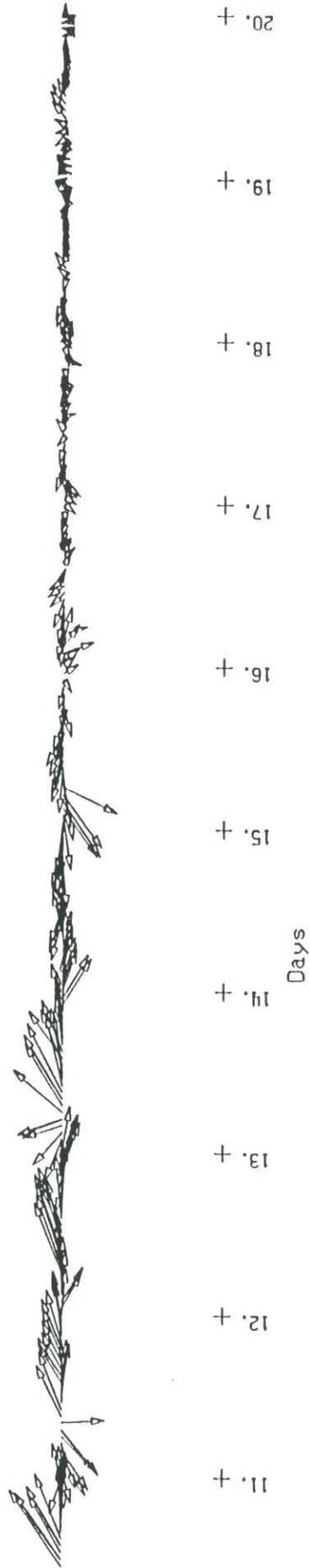
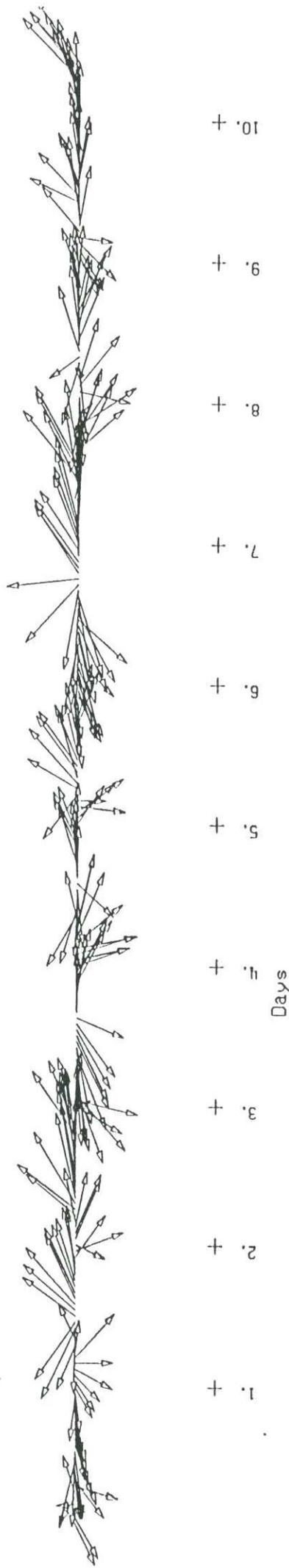


Fig. I.21 Current velocity vector Jul-Aug 1992

current velocity vector RCM 2905 22.7-11.8.1992

vel scale: 1 cm = 20. cm/s.

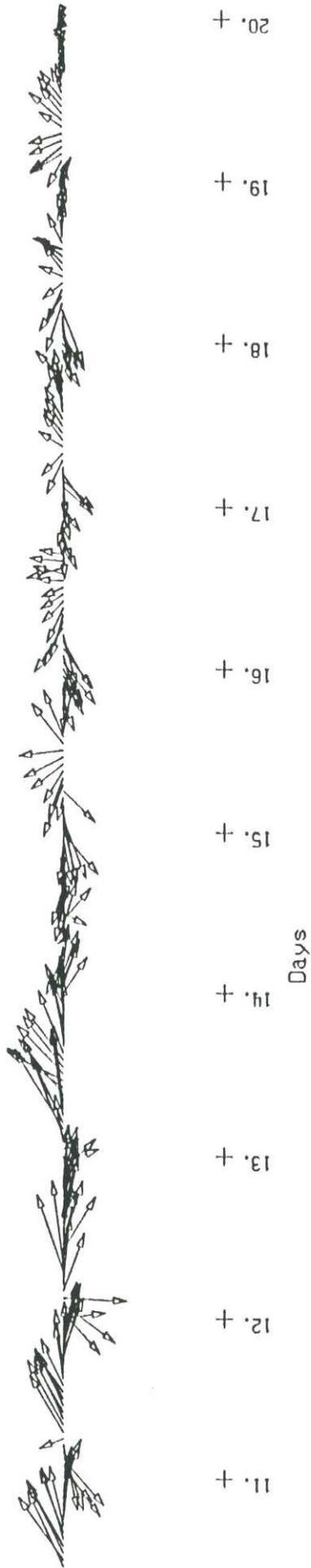
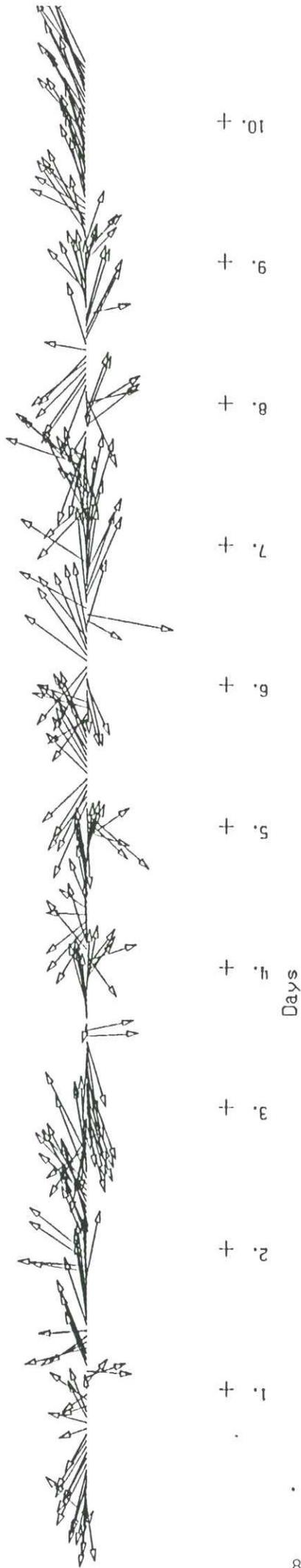


Fig. I.22 Current velocity vector Jul-Aug 1992

CM 2905 July 92
Progressive vel vector plot (vel scale: 1cm=150 cm/s.)

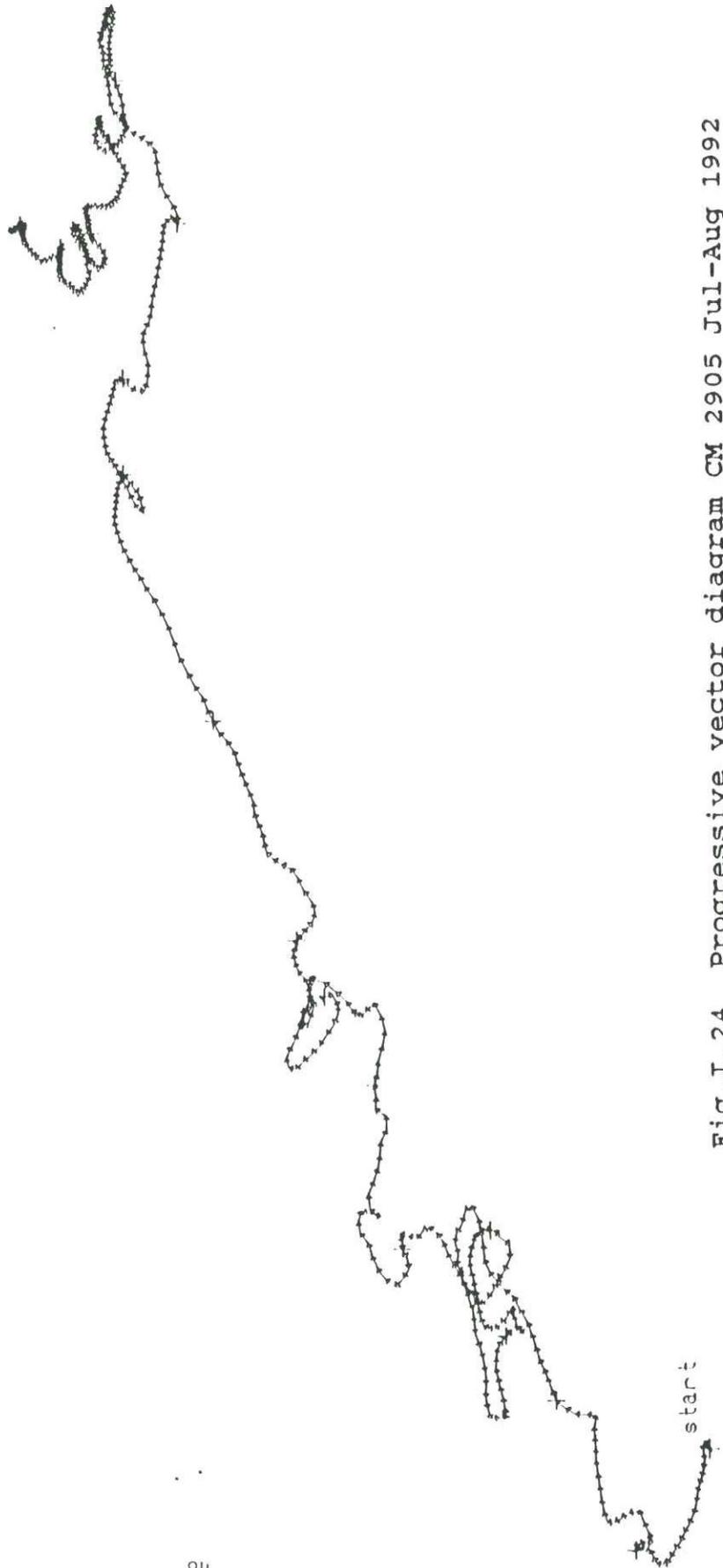


Fig.I.24 Progressive vector diagram CM 2905 Jul-Aug 1992

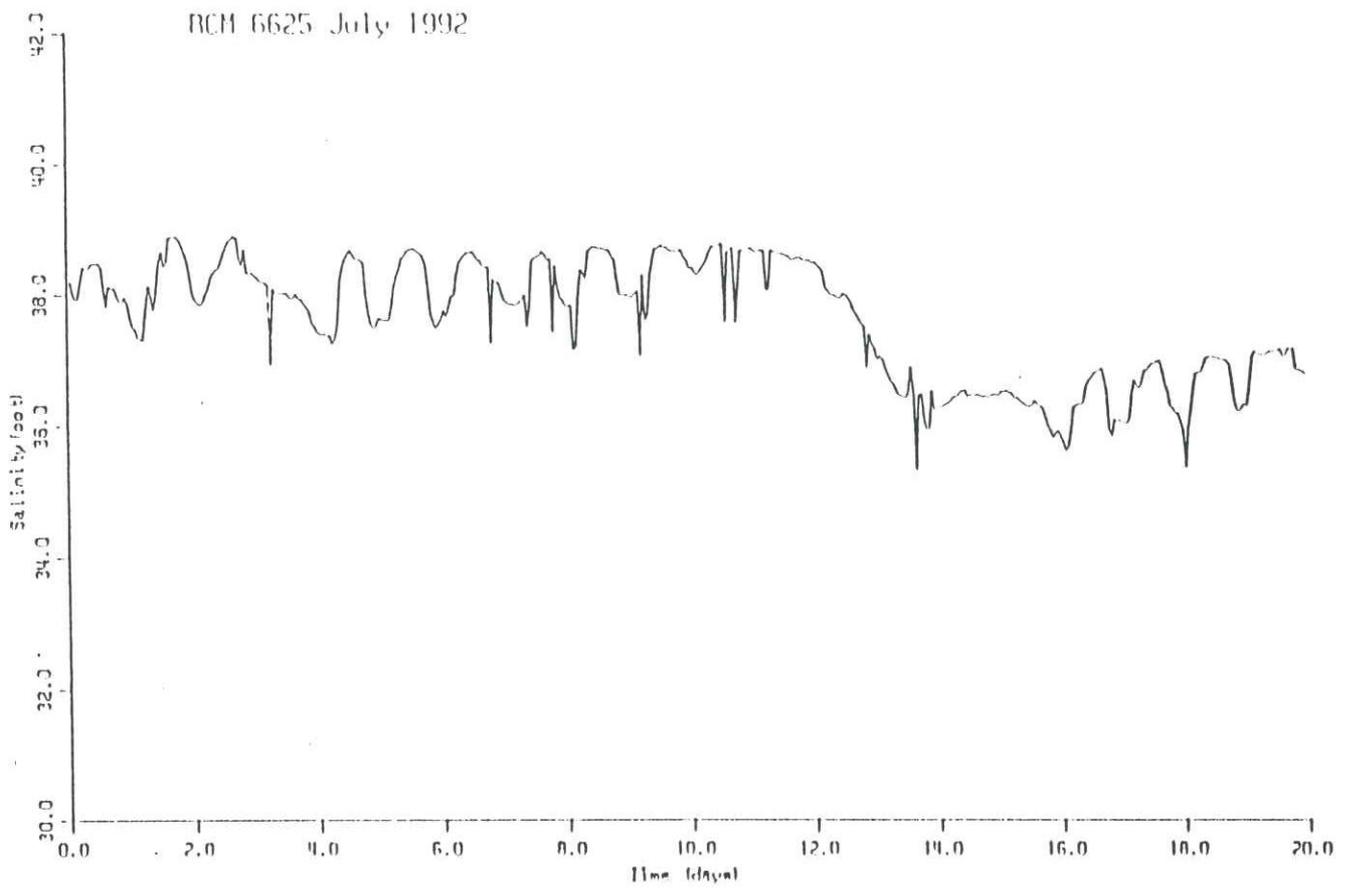
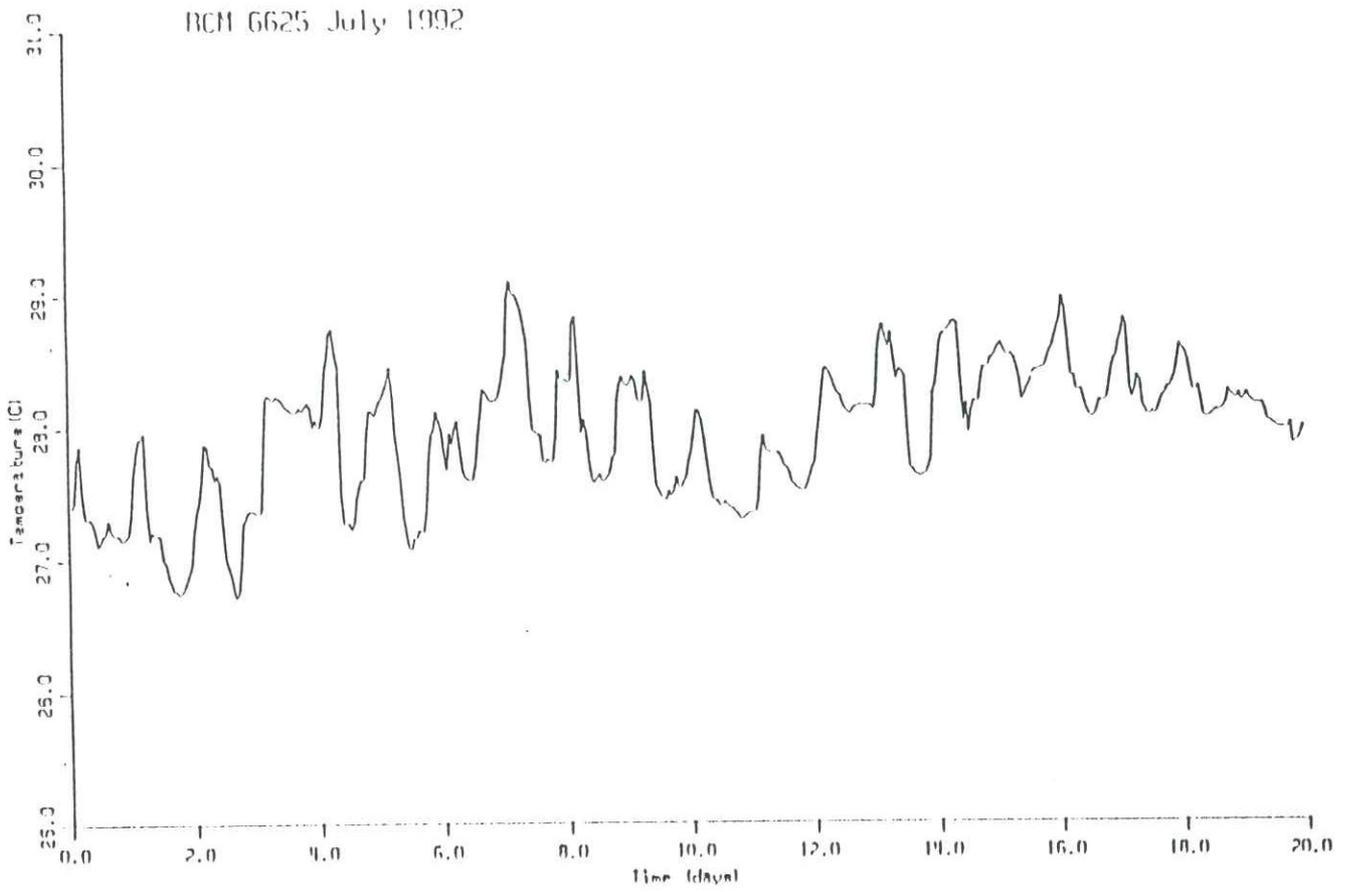


Fig.I.25 Temp. and salinity time series at CM 6625 Jul Aug 1992

Mersin wind Jan 1992
vel scale: 1 cm = 3. m/s.

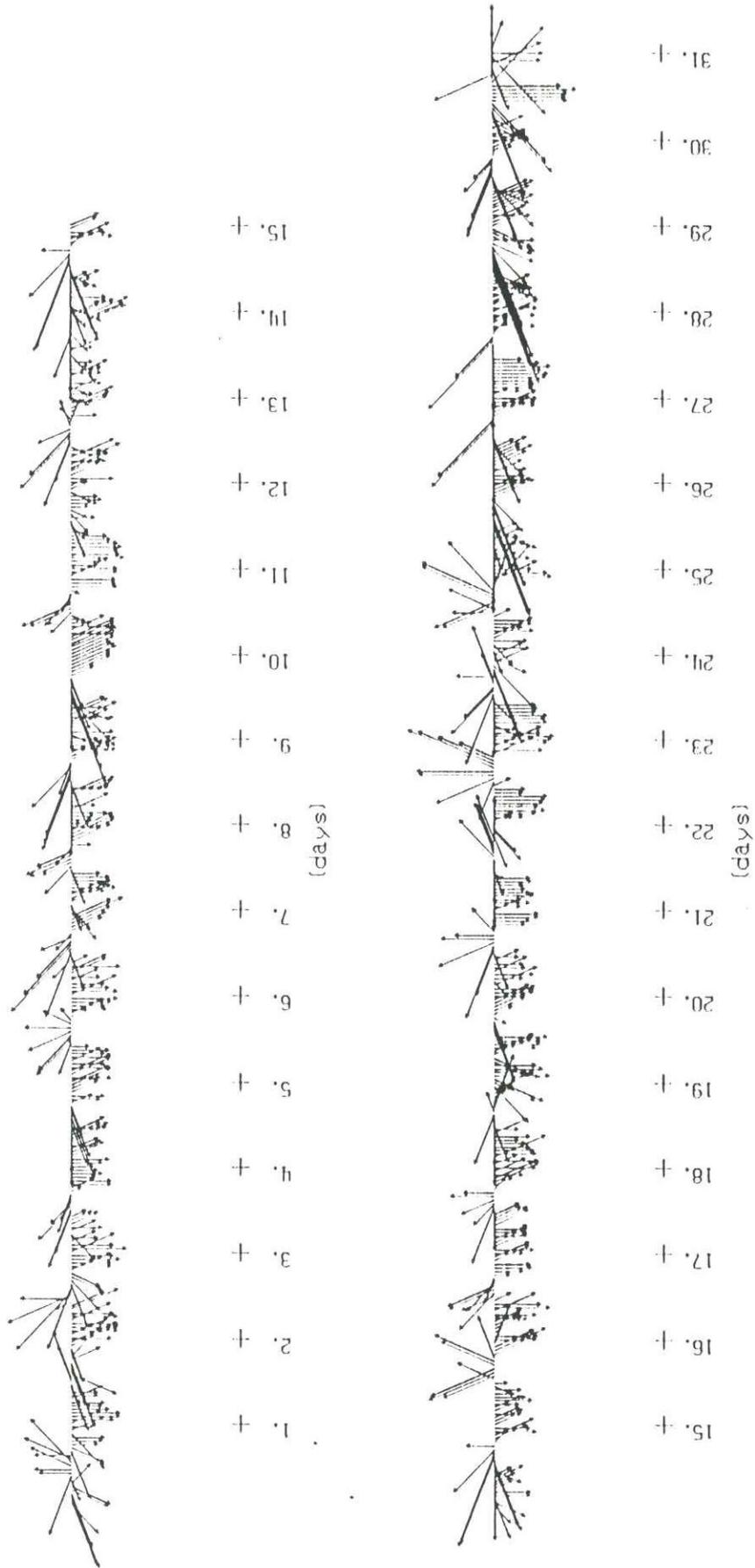


Fig.I.26 Mersin wind velocity vector

Mersin wind Feb 1992
vel scale: 1 cm = 3. m/s.

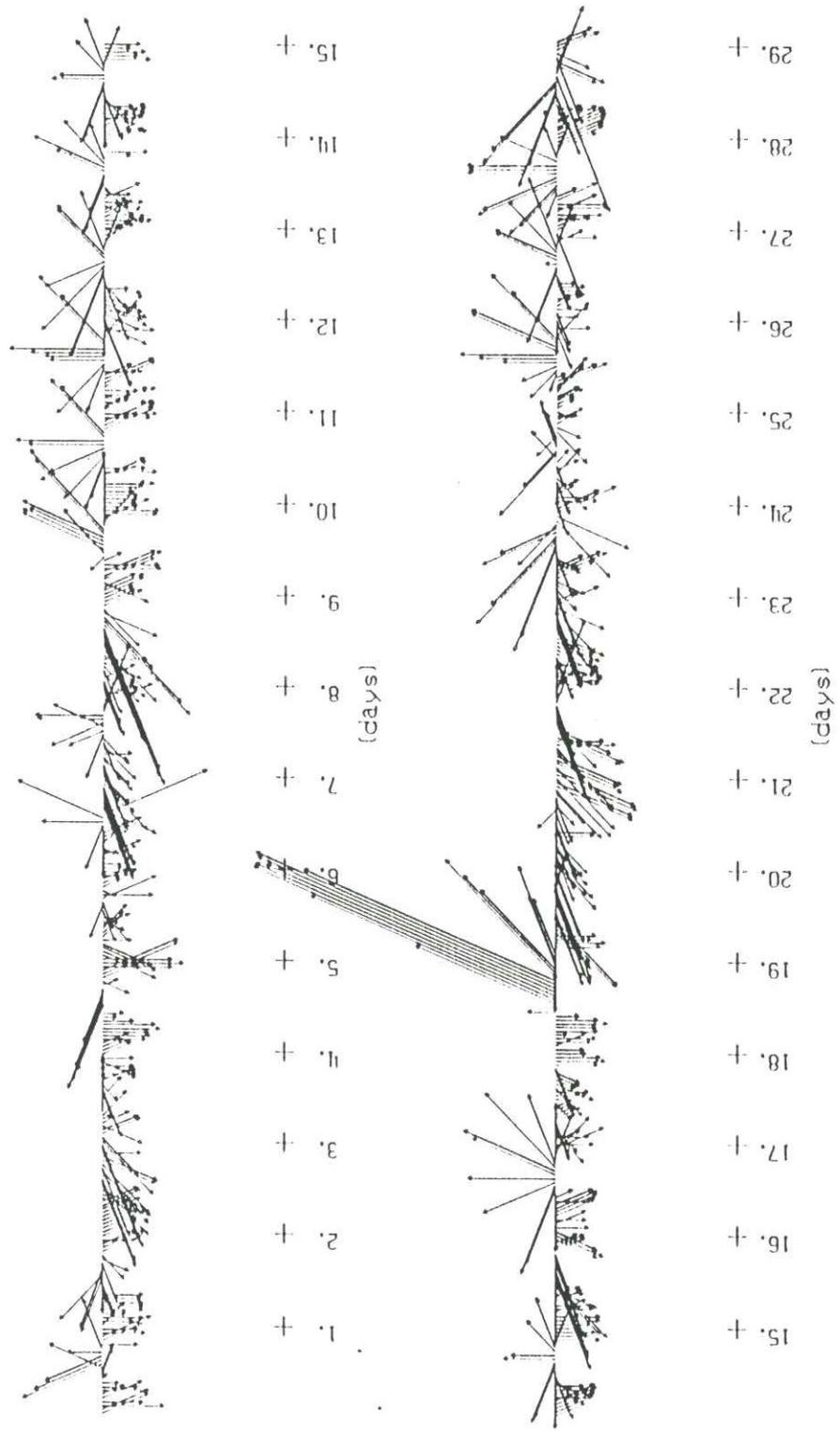


Fig.I.26 Mersin wind velocity vector (cont)

Mersin wind March 1992
vel scale: 1 cm = 3. m/s.

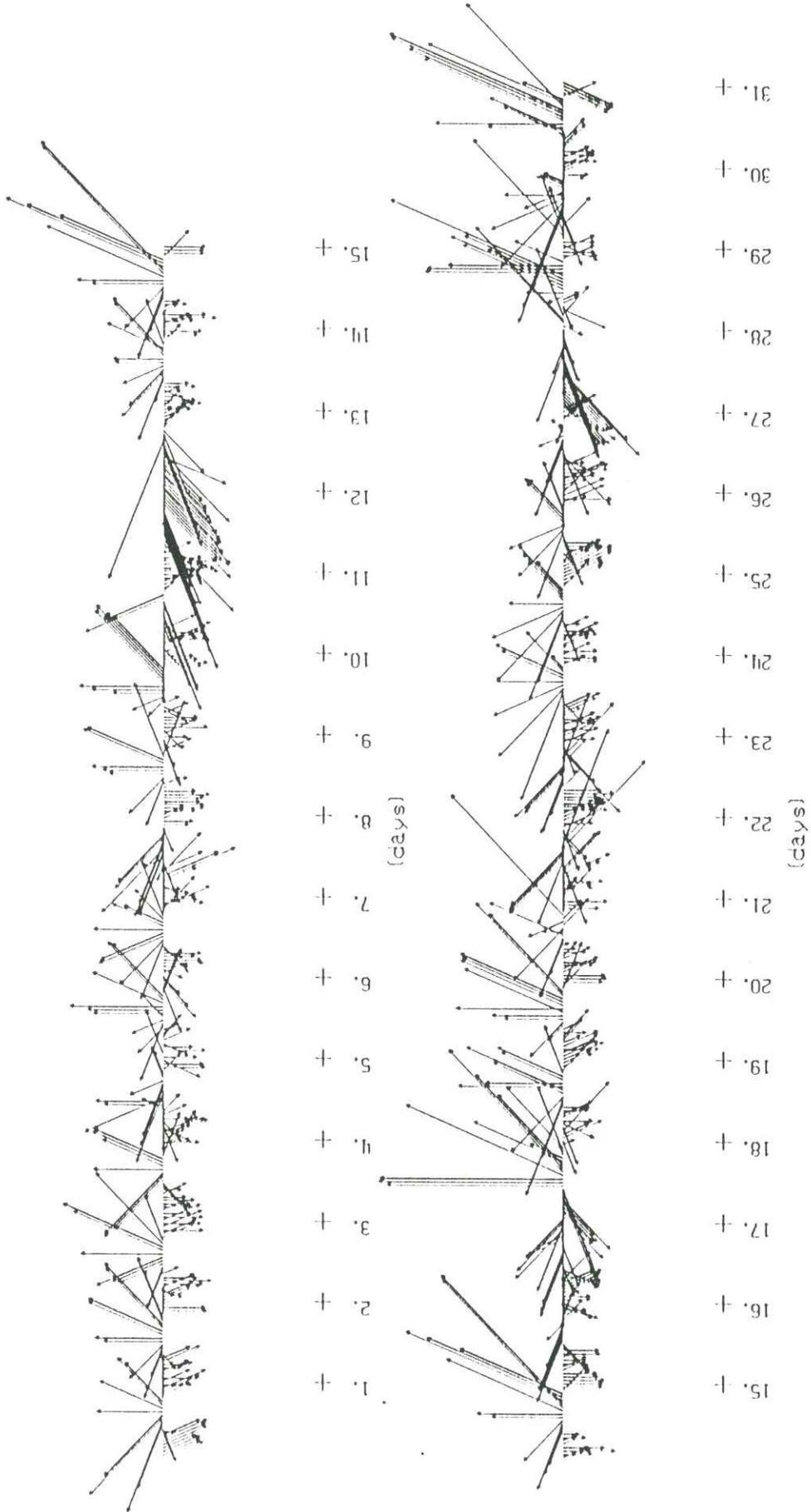


Fig. I.26 Mersin wind velocity vector (cont)

Mersin wind April 1992
vel scale: 1 cm = 3. m/s.

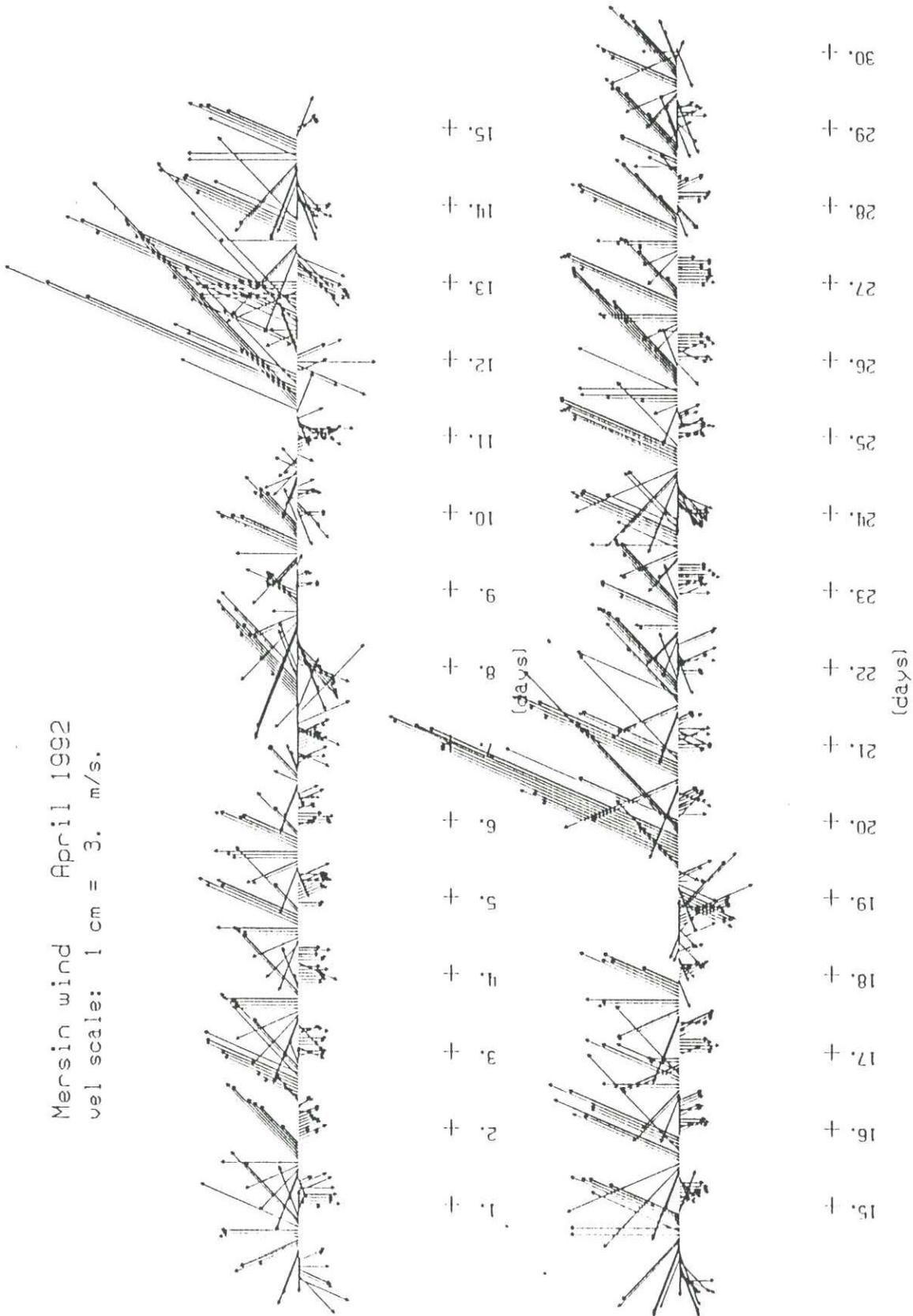


Fig.I.26 Mersin wind velocity vector (cont)

Mersin wind May 1992
vel scale: 1 cm = 3. m/s.

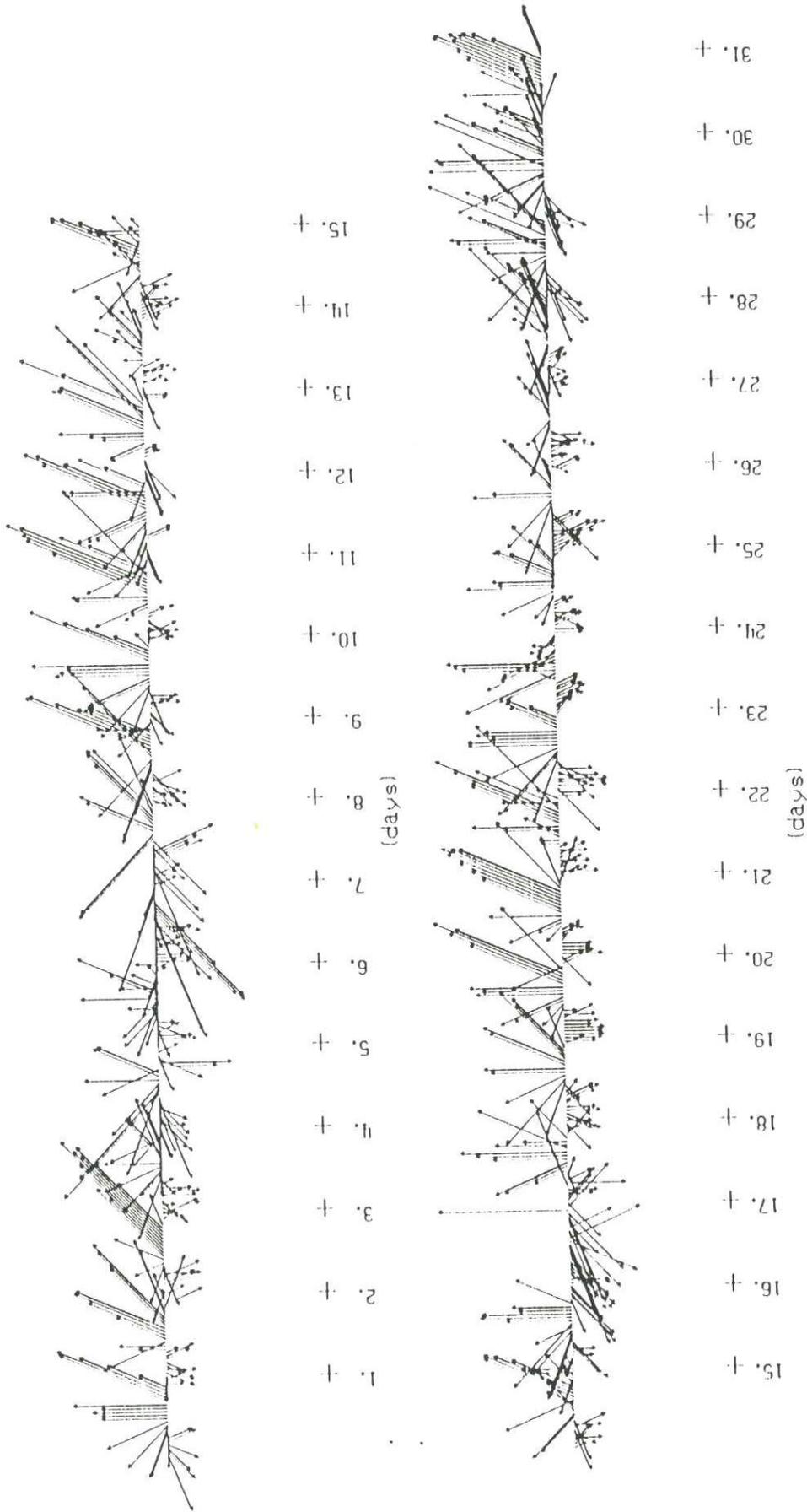


Fig.I.26 Mersin wind velocity vector (cont)

Mersin wind June 1992
vel scale: 1 cm = 3. m/s.

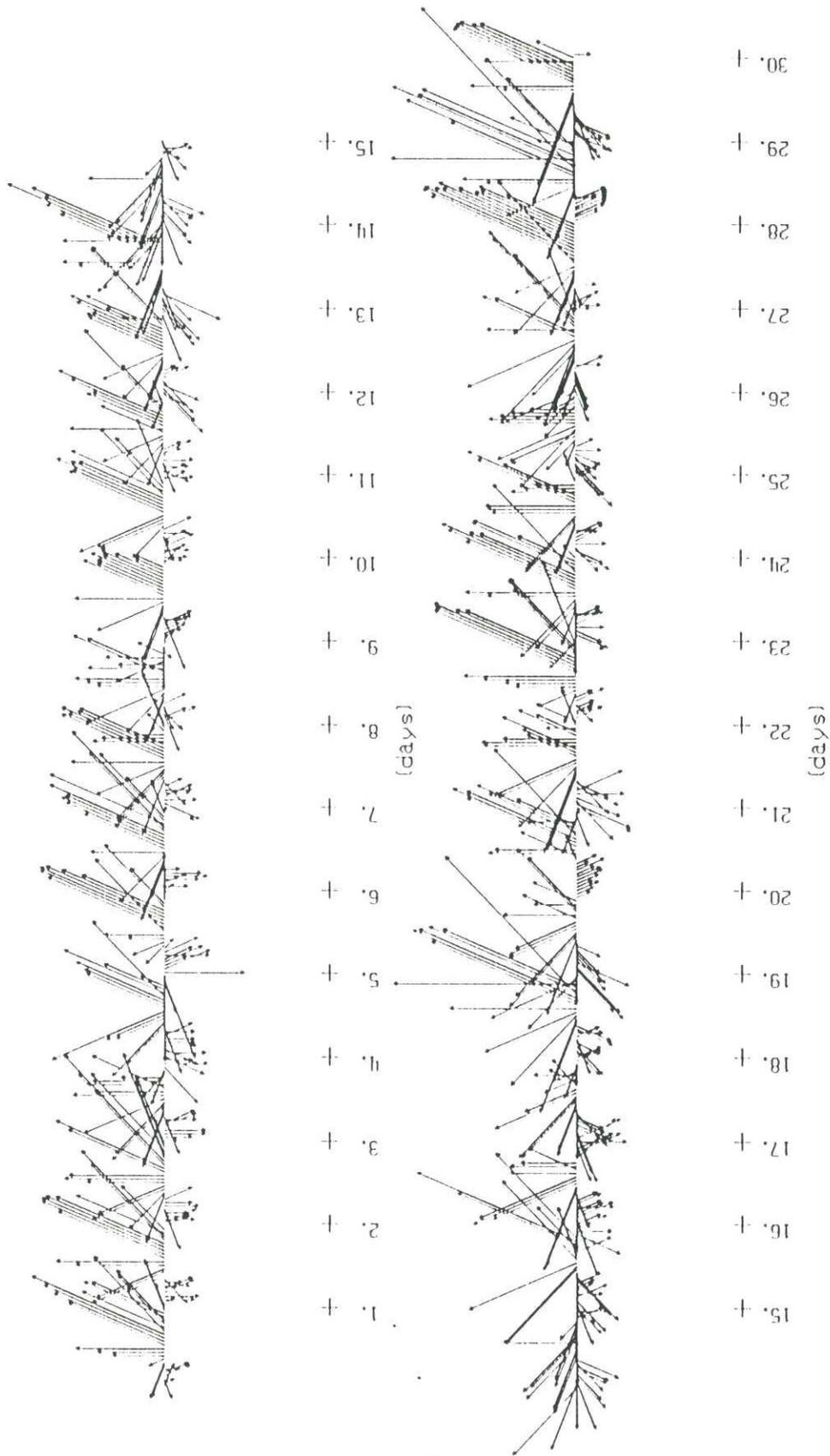


Fig. I.26 Mersin wind velocity vector (cont)

Mersin wind July 1992
vel scale: 1 cm = 3. m/s.

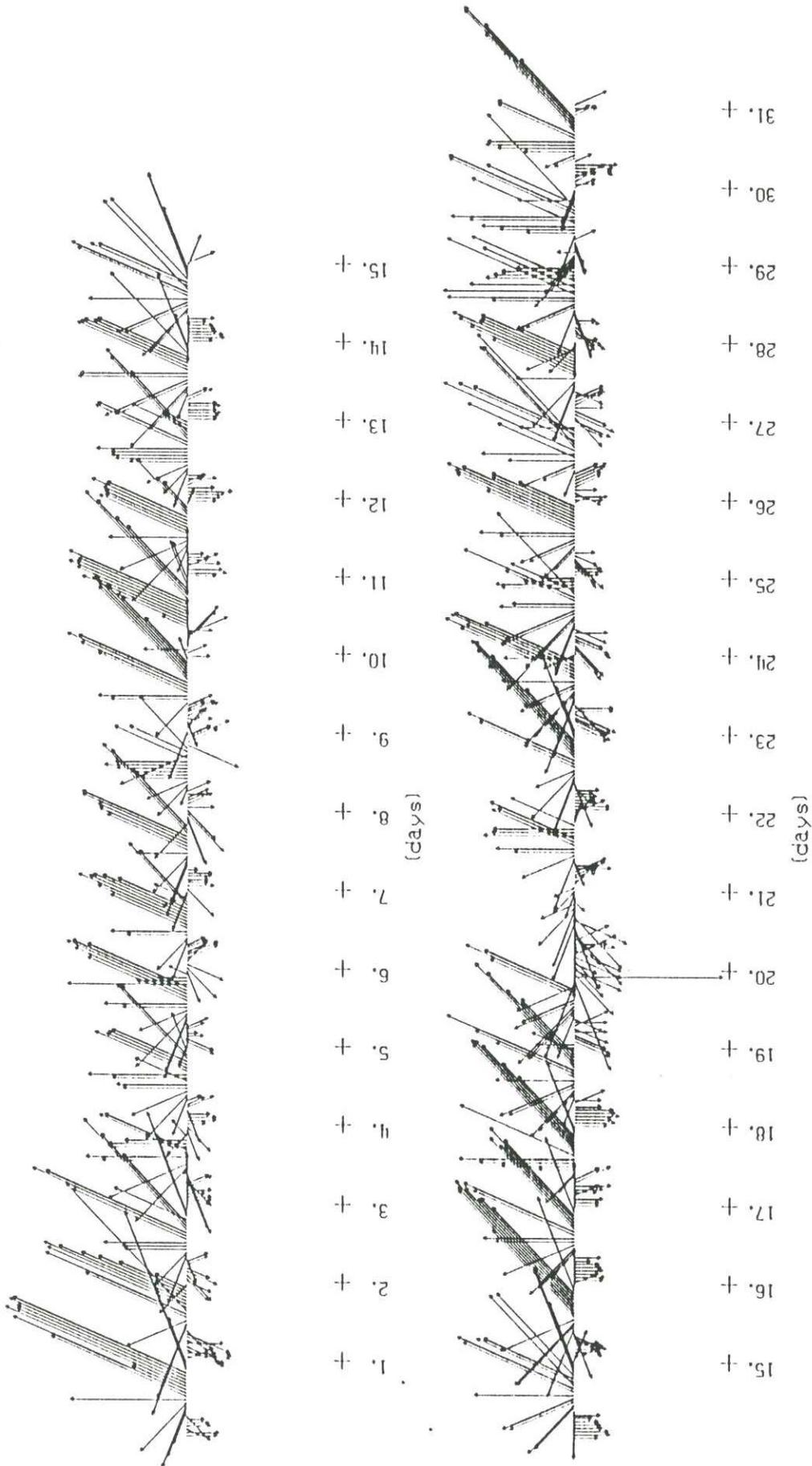


Fig.I.26 Mersin wind velocity vector (cont)

Mersin wind Aug 1992
vel scale: 1 cm = 3. m/s.

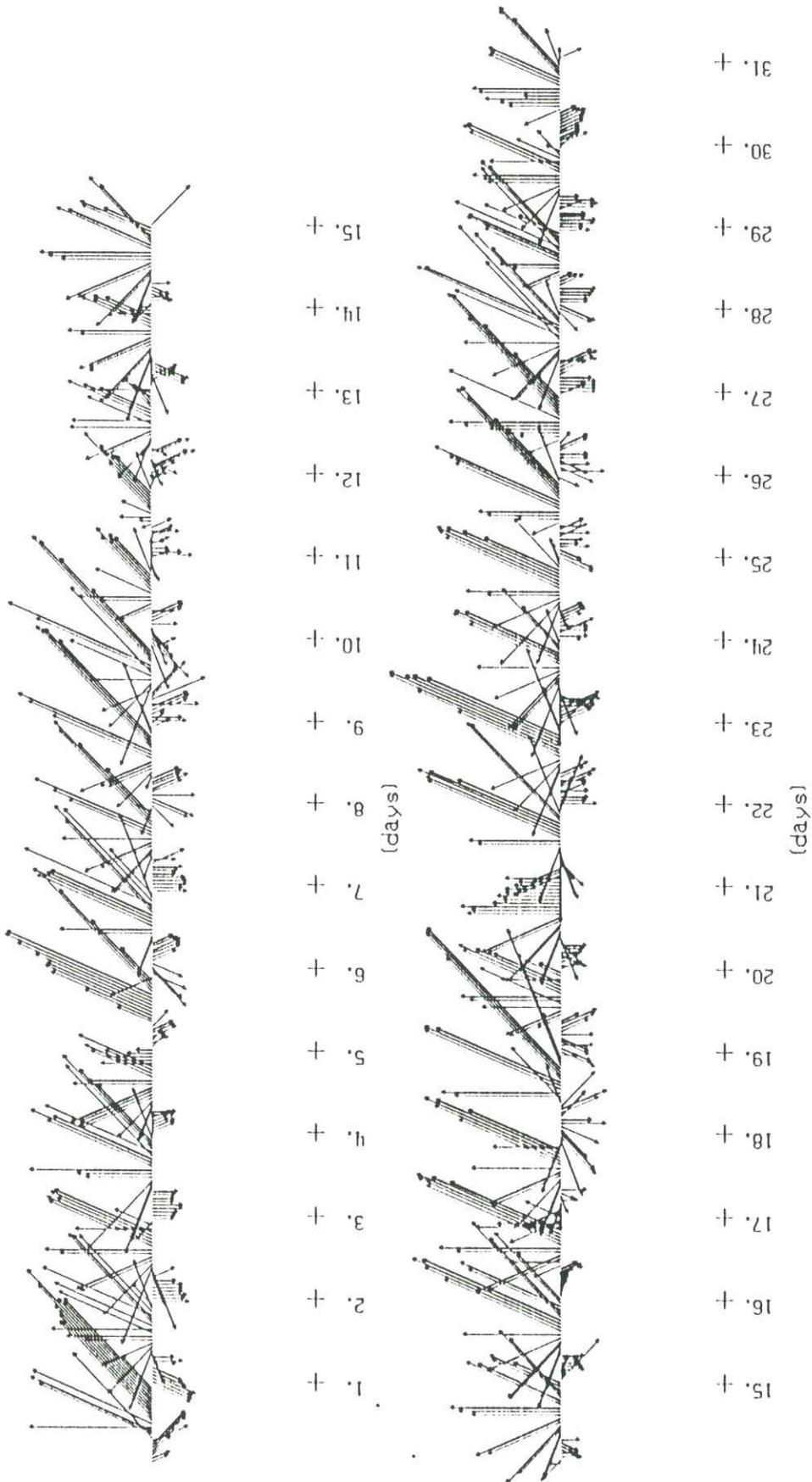


Fig. I.26 Mersin wind velocity vector (cont)

Mersin wind Sep 1992
vel scale: 1 cm = 3. m/s.

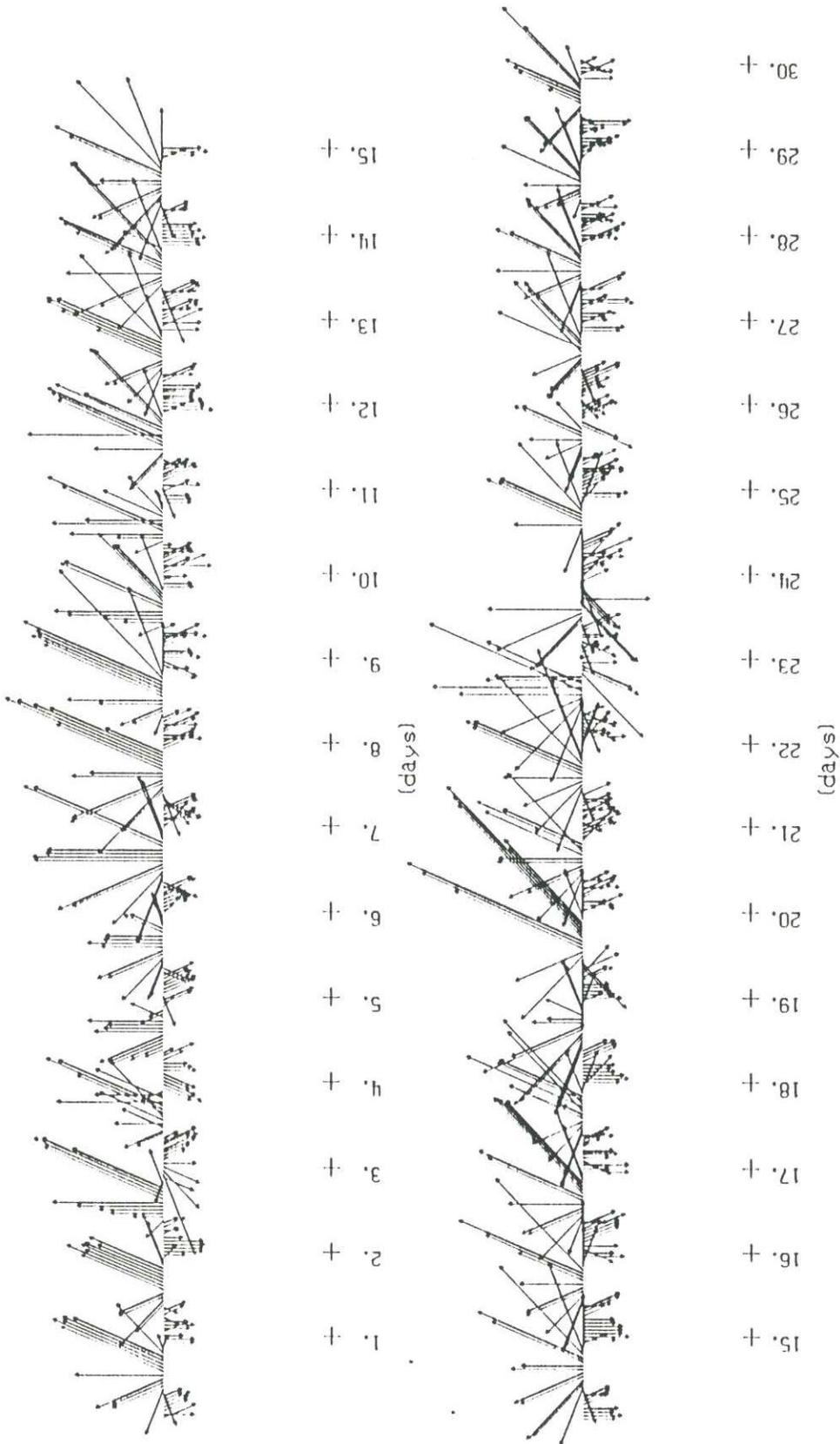


Fig. I.26 Mersin wind velocity vector (cont)

Mersin wind Oct 1992
vel scale: 1 cm = 3. m/s.

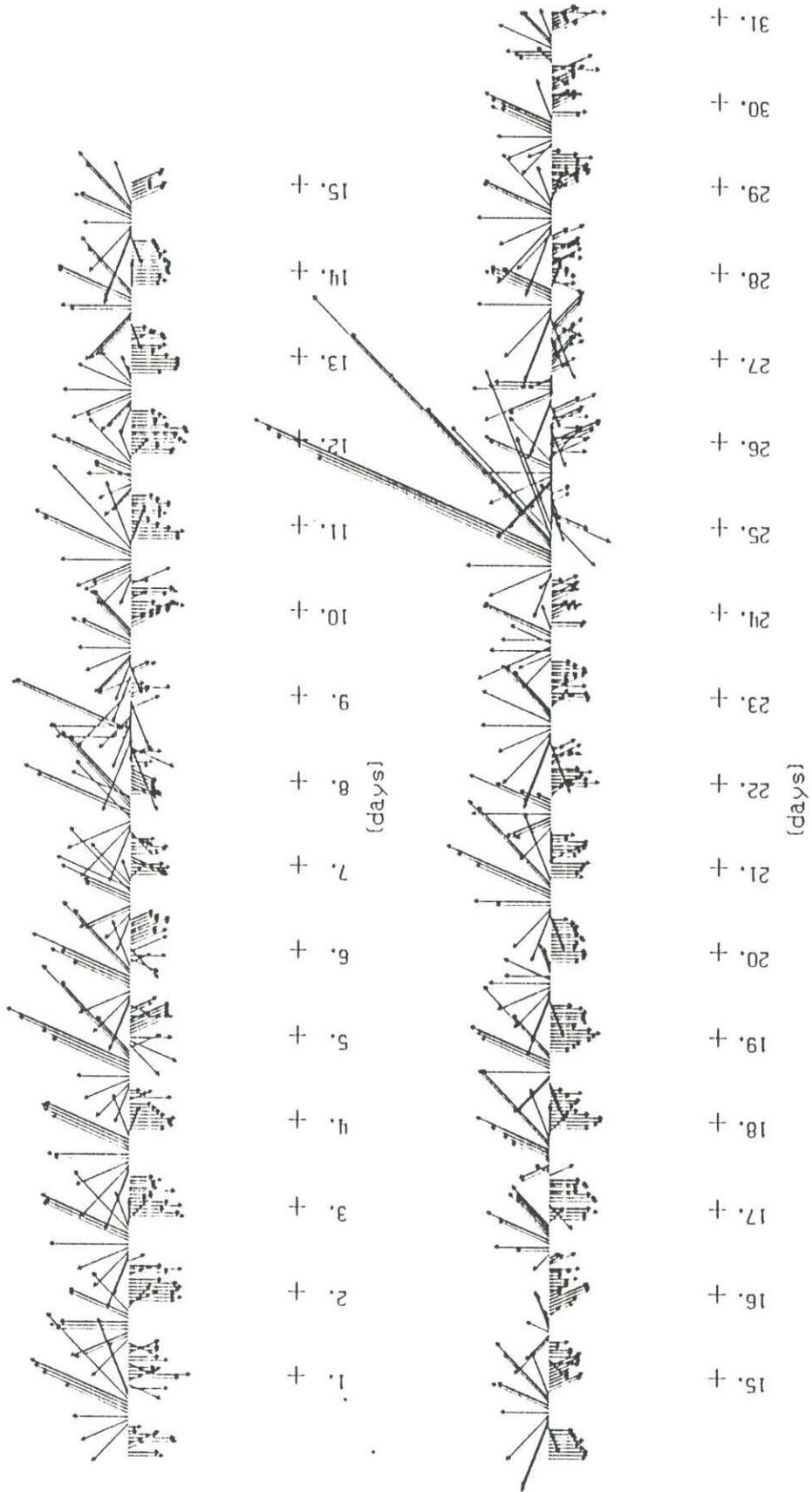
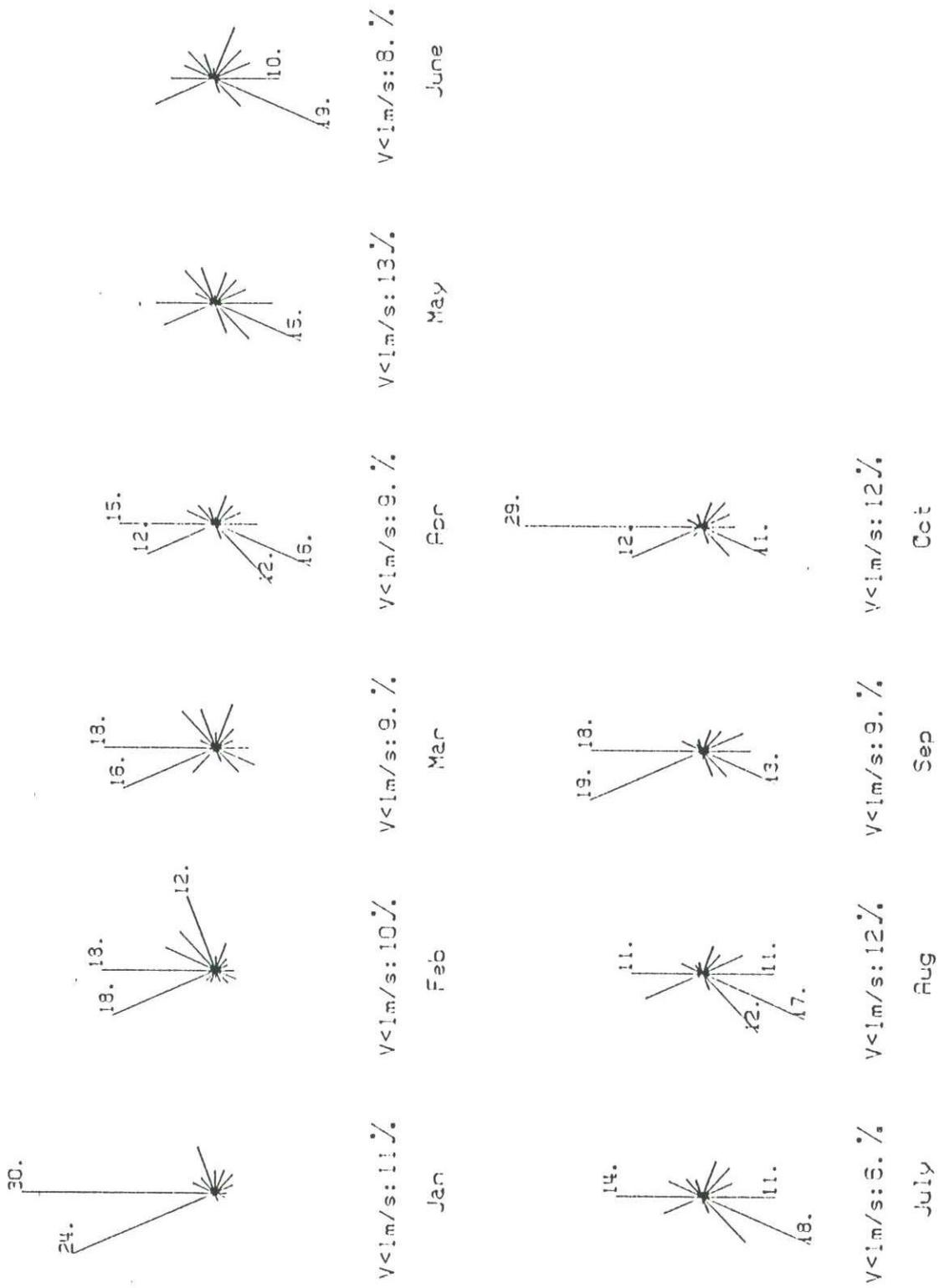


Fig.I.26 Mersin wind velocity vector (cont)



1992 monthly wind frequency

Fig.I.27 Wind frequency

Mersin wind velocity vector 1977

vel scale: 1 cm \rightarrow 3. m/s.

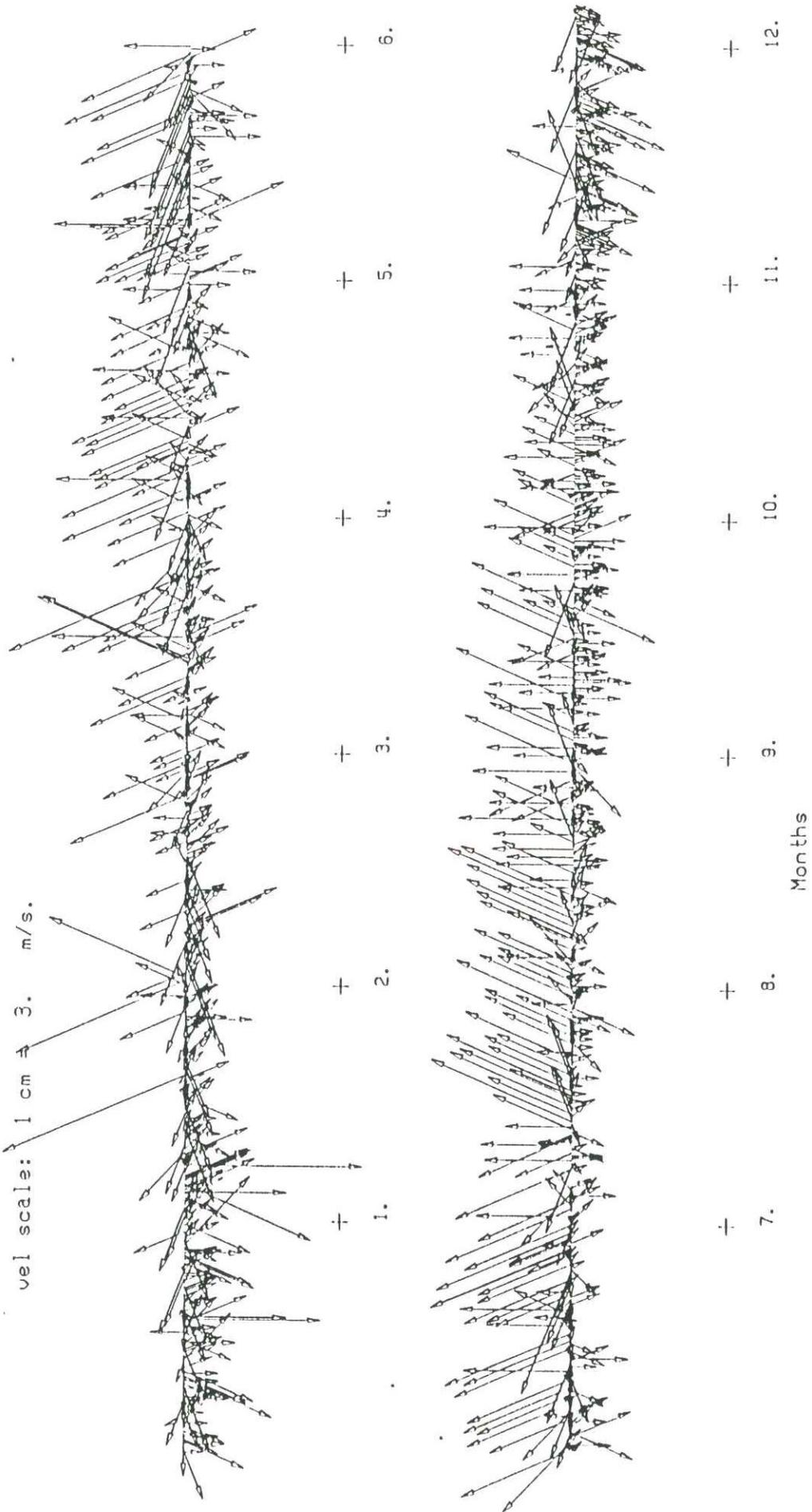


Fig.I.28 Mersin wind velocity vector 1977

Mersin wind velocity vector 1978

vel scale: 1 cm = 3. m/s.

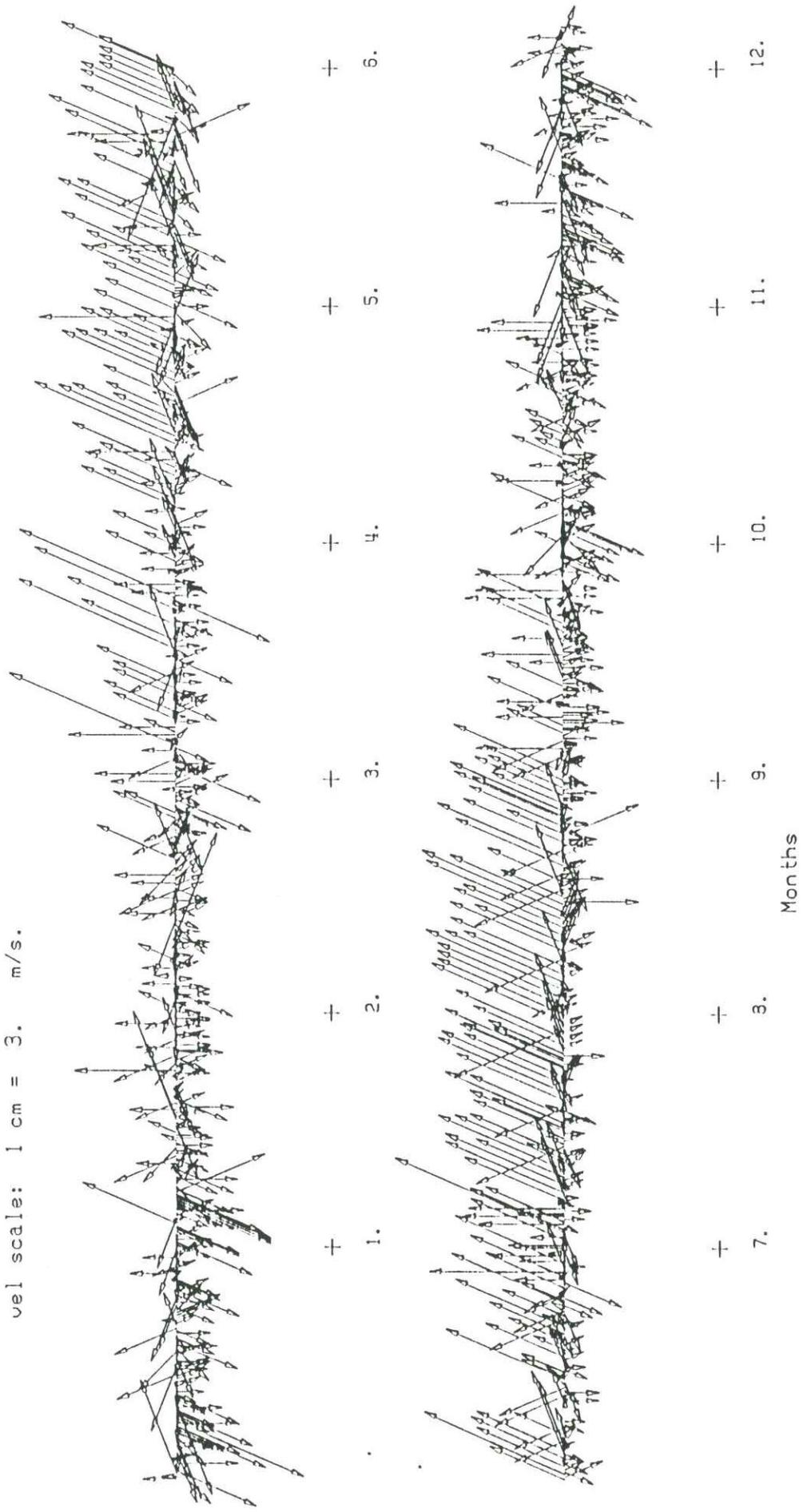


Fig.I.29 Mersin wind velocity vector 1978

Mersin wind velocity vector 1979

vel scale: 1 cm = 3. m/s.

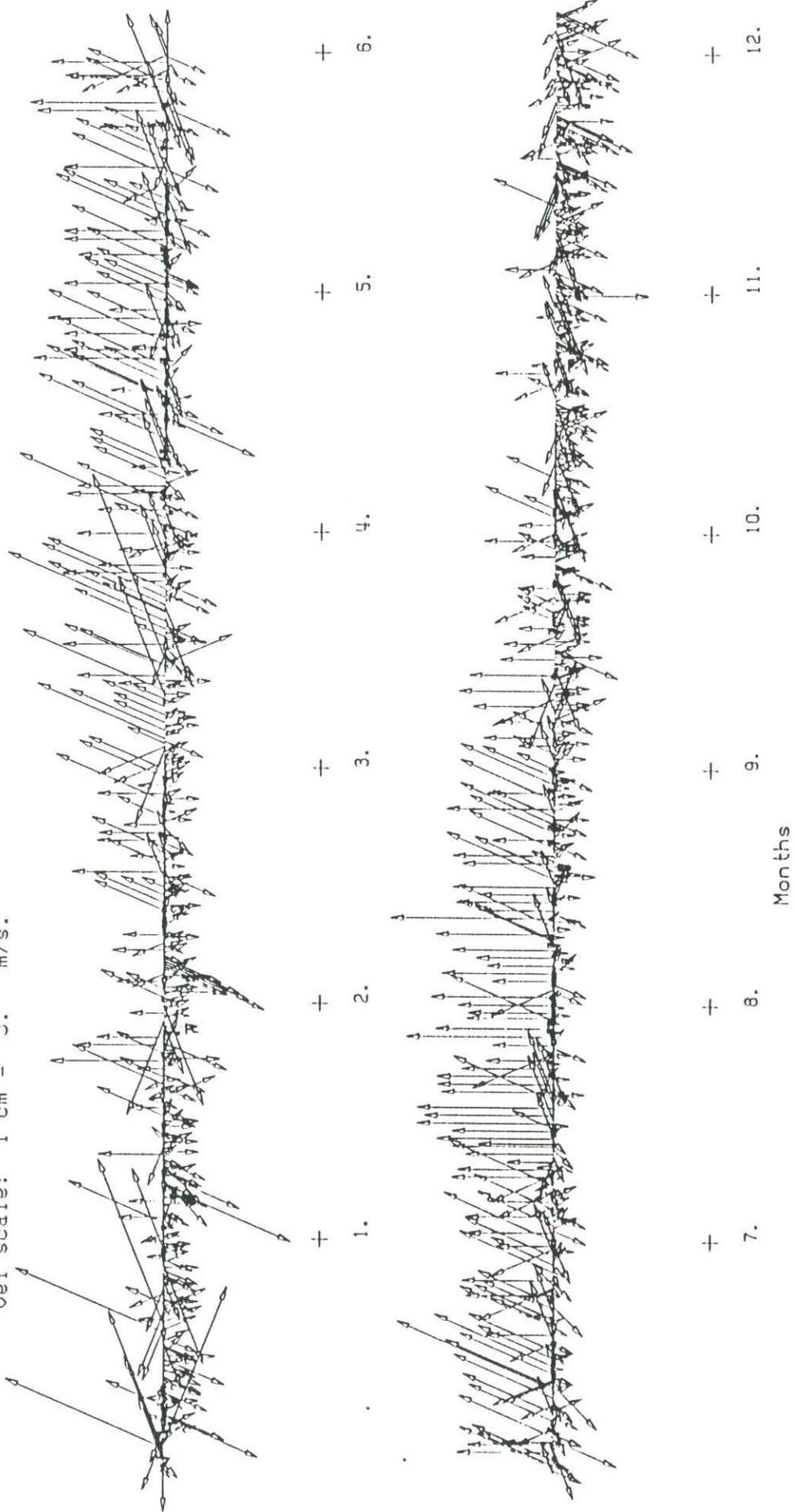


Fig.I.30 Mersin wind velocity vector 1979

Mersin wind velocity vector 1980

vel scale: 1 cm = 3. m/s.

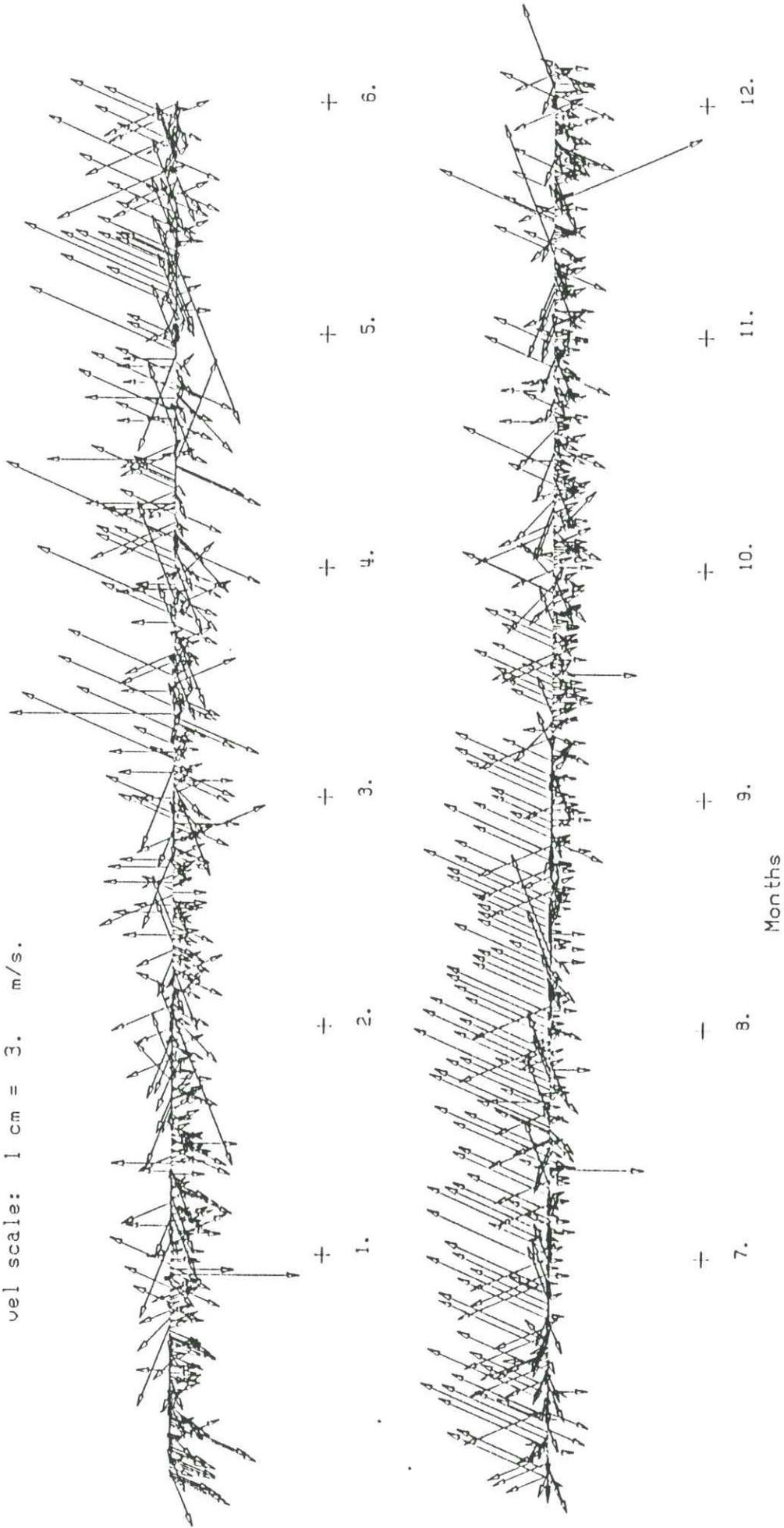


Fig.I.31 Mersin wind velocity vector 1980

Mersin wind velocity vector 1981

vel scale: 1 cm = 3. m/s.

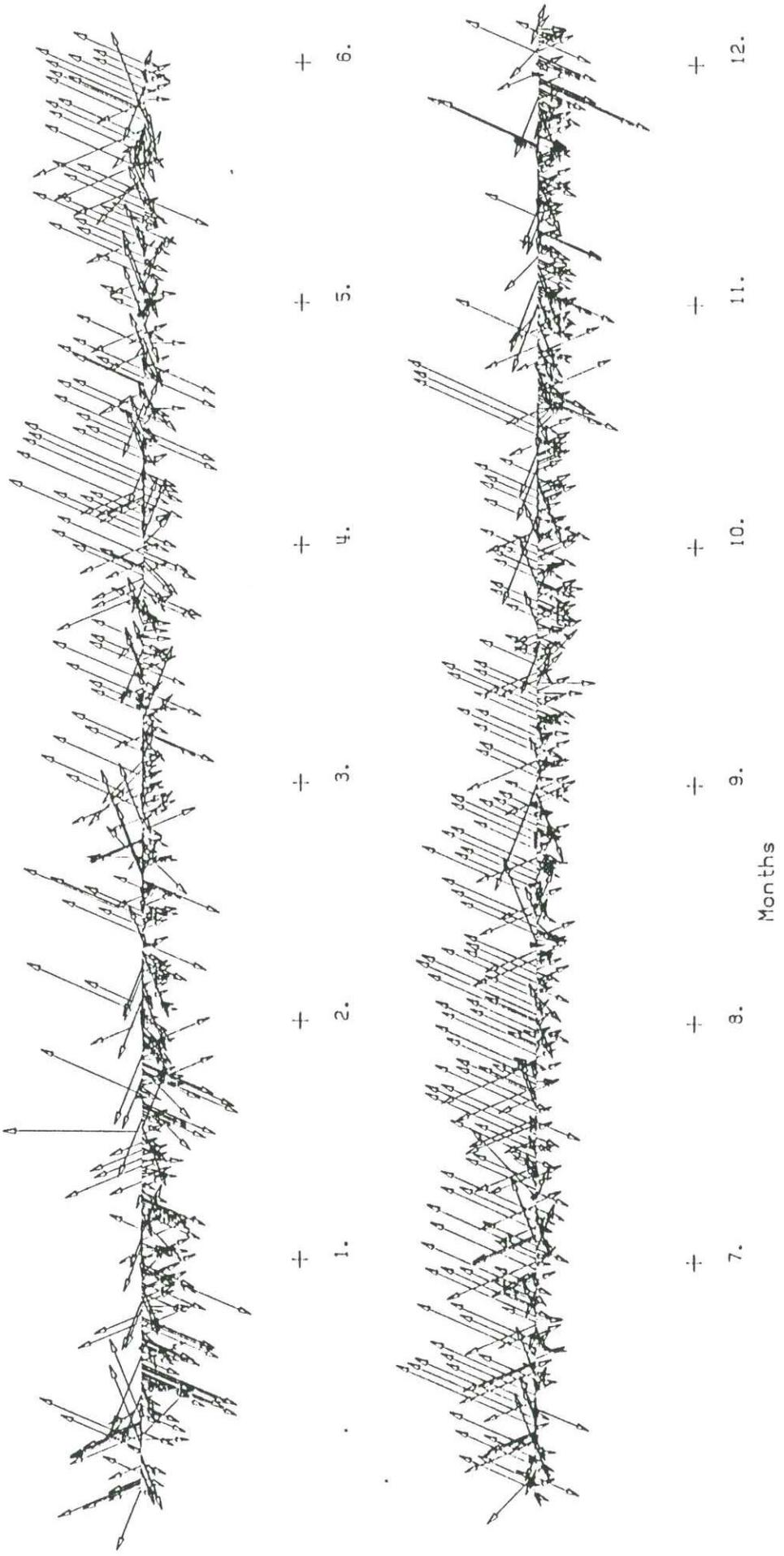


Fig.I.32 Mersin wind velocity vector 1981

Mersin wind velocity vector 1982

vel scale: 1 cm = 3. m/s.

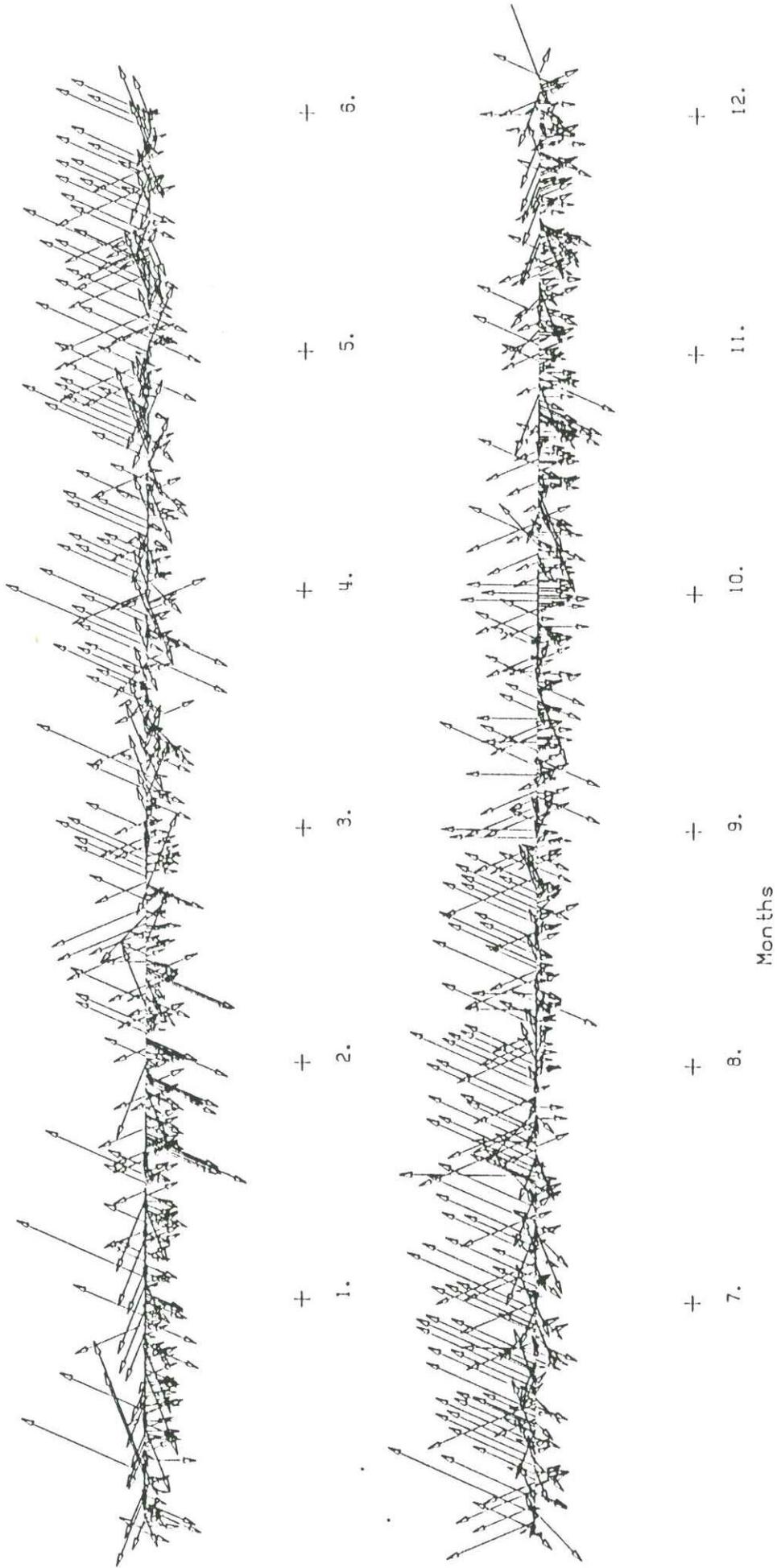


Fig.I.33 Mersin wind velocity vector 1982

Mersin wind velocity vector 1983

vel scale: 1 cm = 3. m/s.

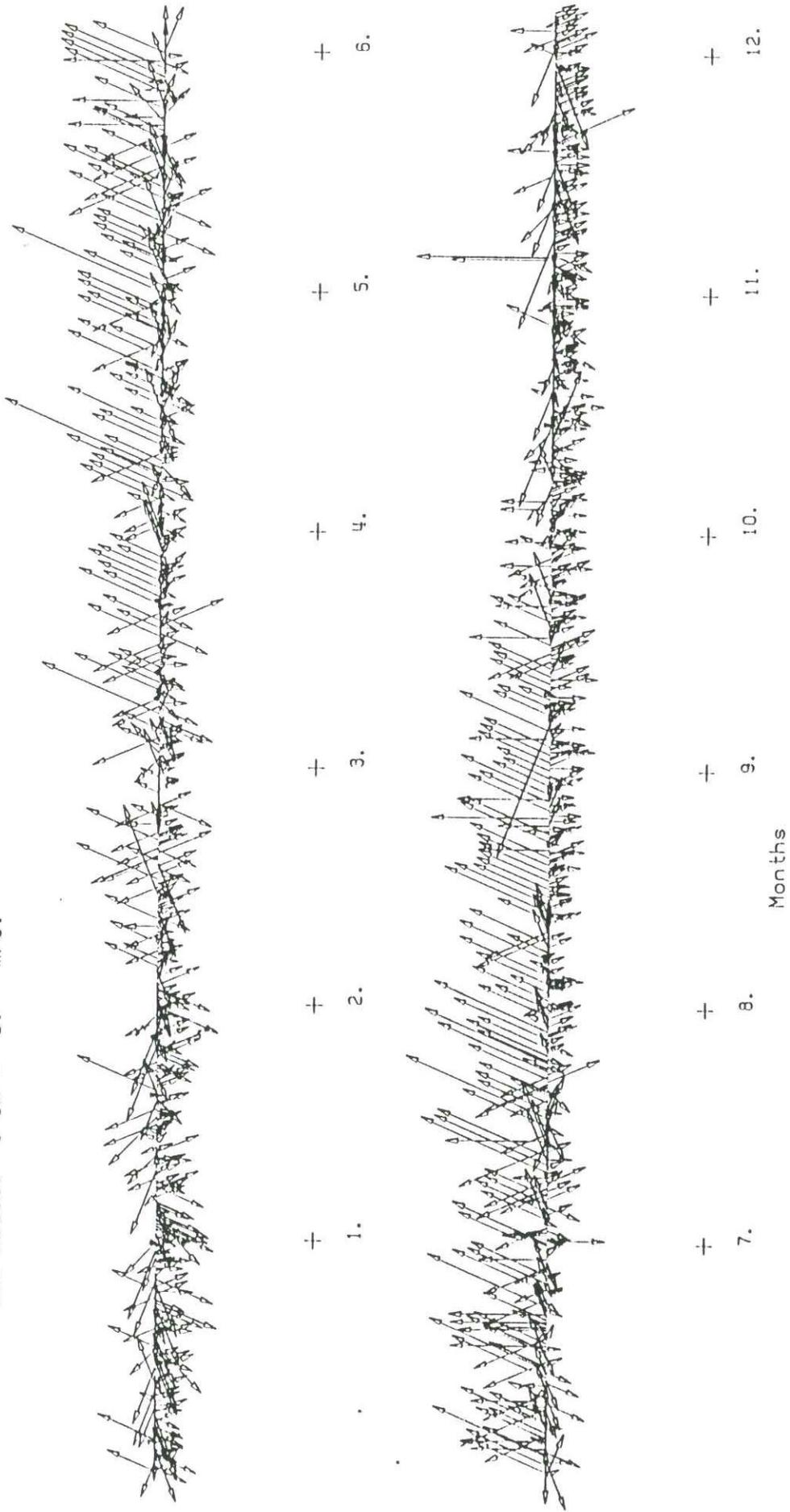
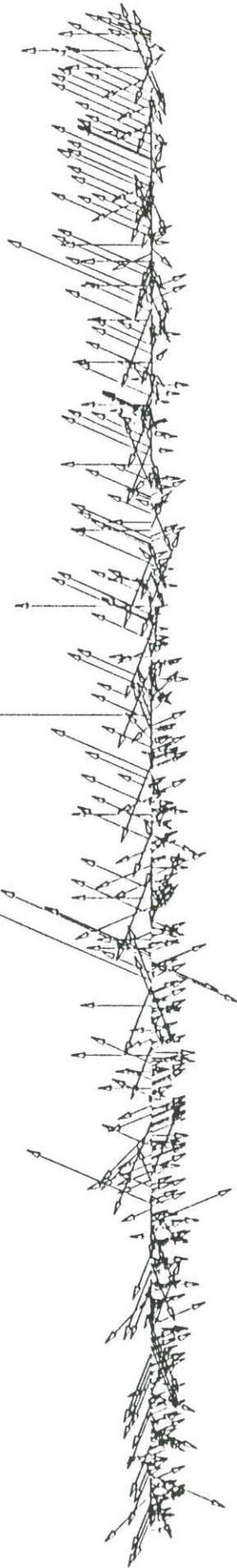


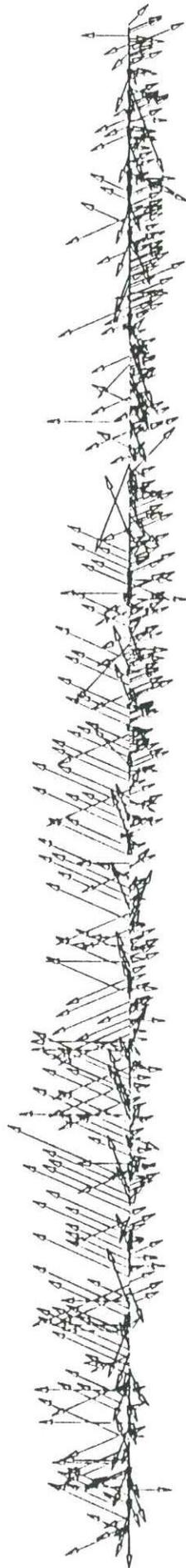
Fig.I.34 Mersin wind velocity vector 1983

Mersin wind velocity vector 1984

vel scale: 1 cm = 3. m/s.



+ 1. 2. 3. 4. 5. 6.



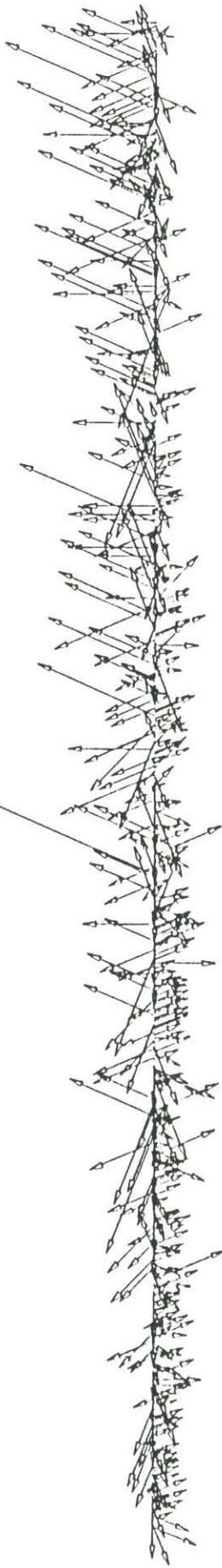
+ 7. 8. 9. 10. 11. 12.

Months

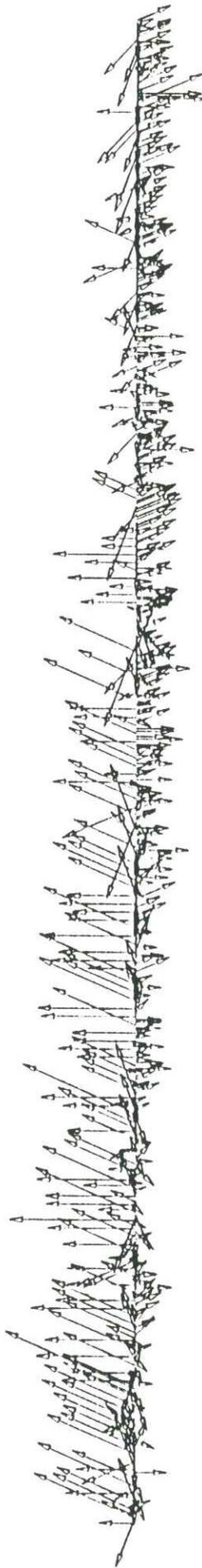
Fig.I.35 Mersin wind velocity vector 1984

Mersin wind velocity vector 1985

vel scale: 1 cm = 3. m/s.



+ 1. 2. 3. 4. 5. 6.

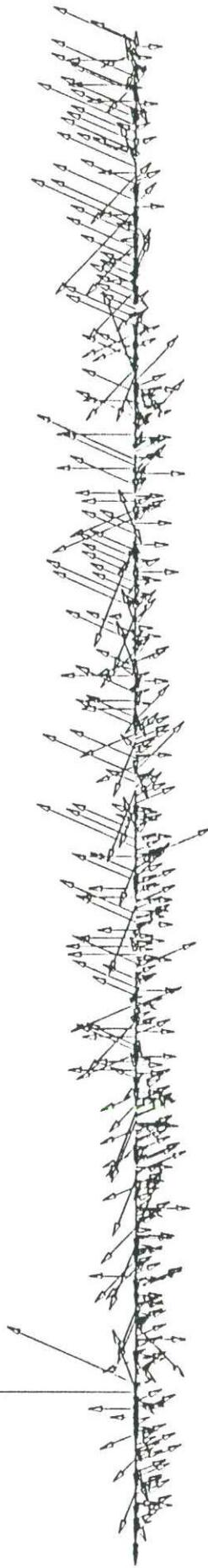


+ 7. 8. 9. 10. 11. 12.
Months

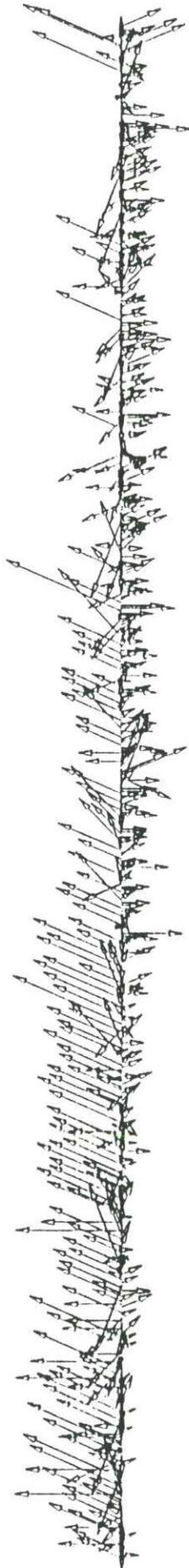
Fig.I.36 Mersin wind velocity vector 1985

Mersin wind velocity vector 1986

vel scale: 1 cm = 3. m/s.



+ 1. 2. 3. 4. 5. 6.



+ 7. 8. 9. 10. 11. 12.

Months

Fig.I.37 Mersin wind velocity vector 1986

Mersin wind velocity vector 1987

vel scale: 1 cm = 3. m/s.

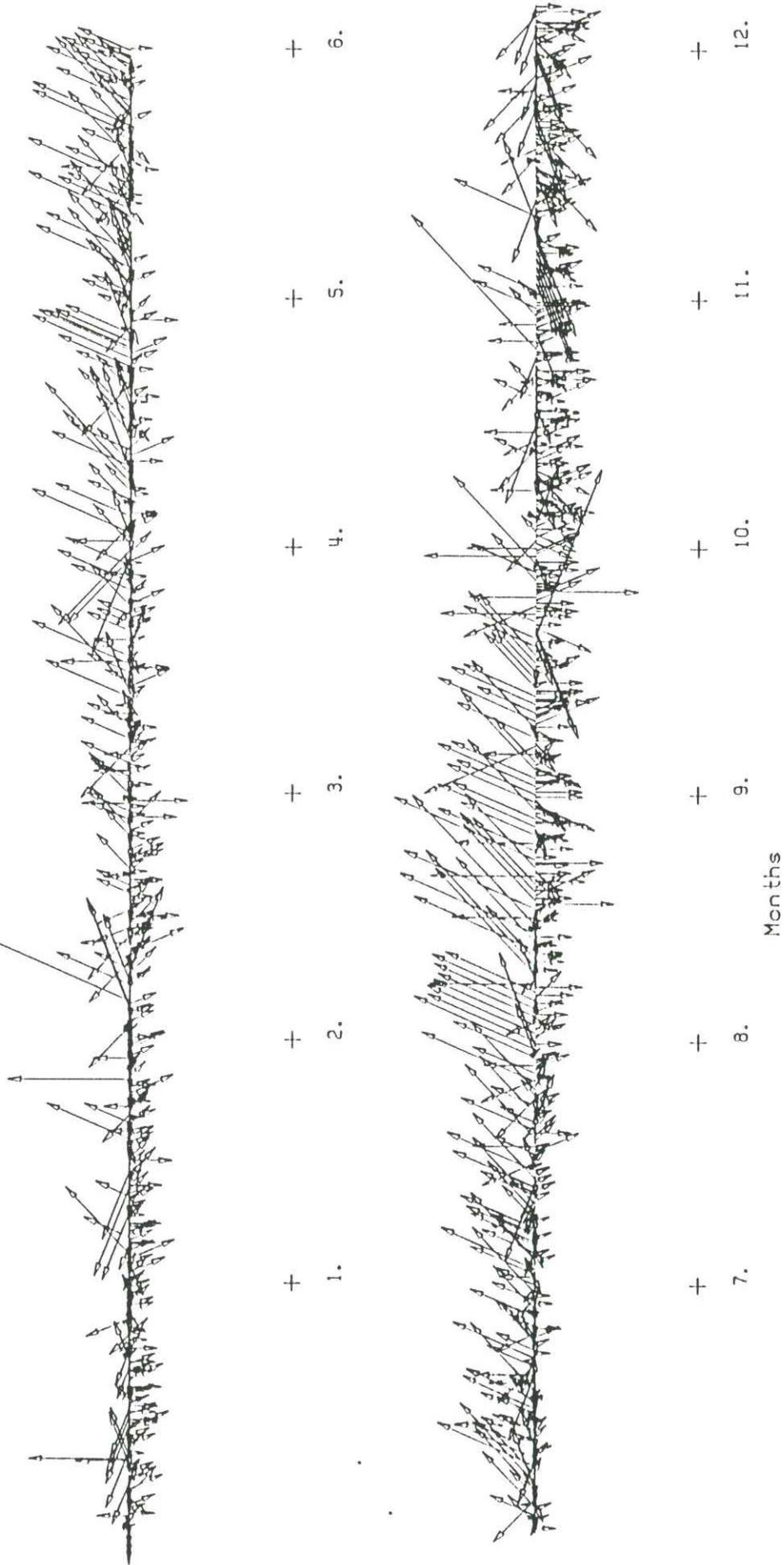


Fig.I.38 Mersin wind velocity vector 1987

Mersin wind velocity vector 1989

vel scale: 1 cm = 3. m/s.

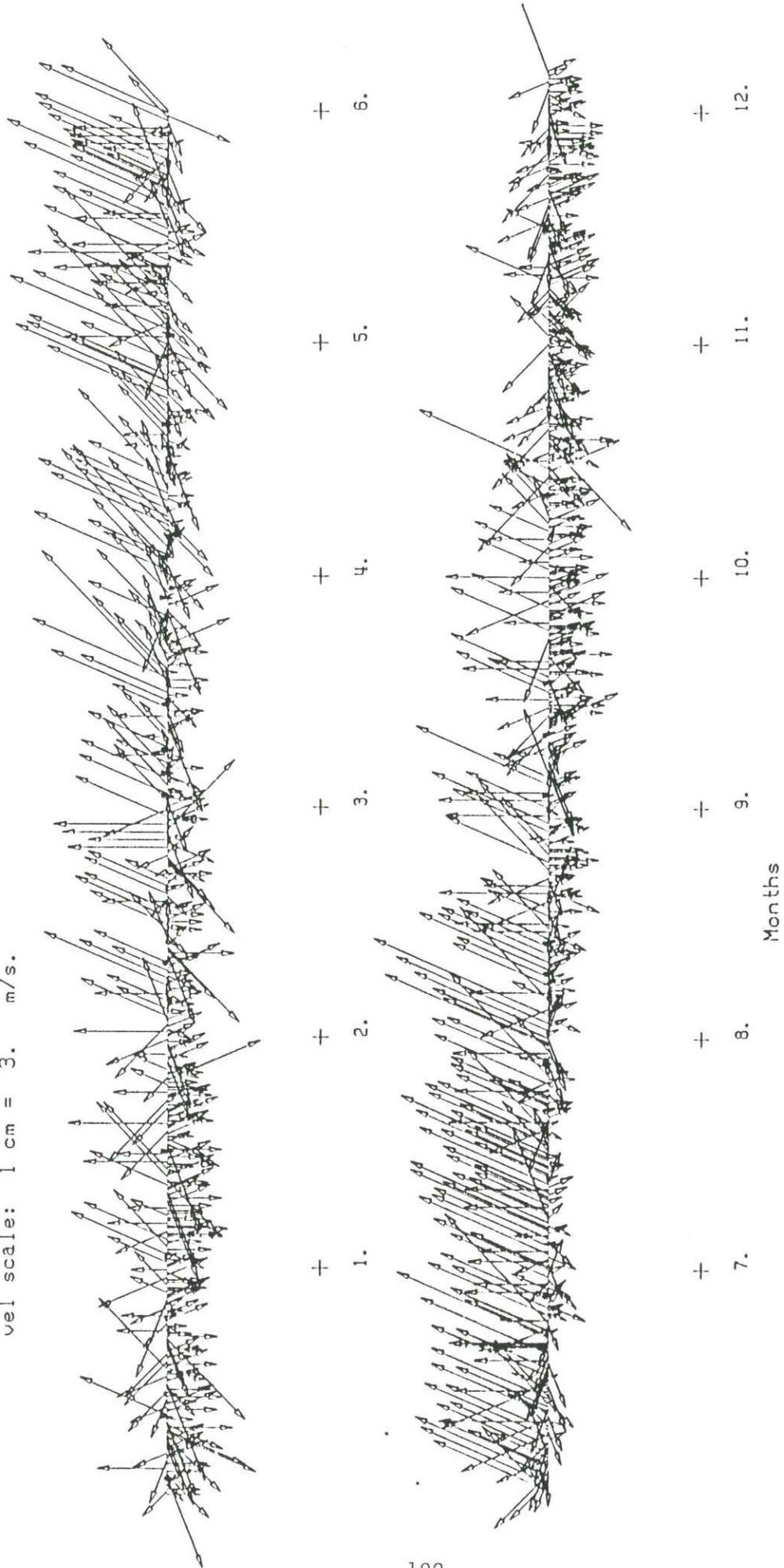


Fig.I.40 Mersin wind velocity vector 1989

Mersin wind velocity vector 1990

vel scale: 1 cm = 3. m/s.

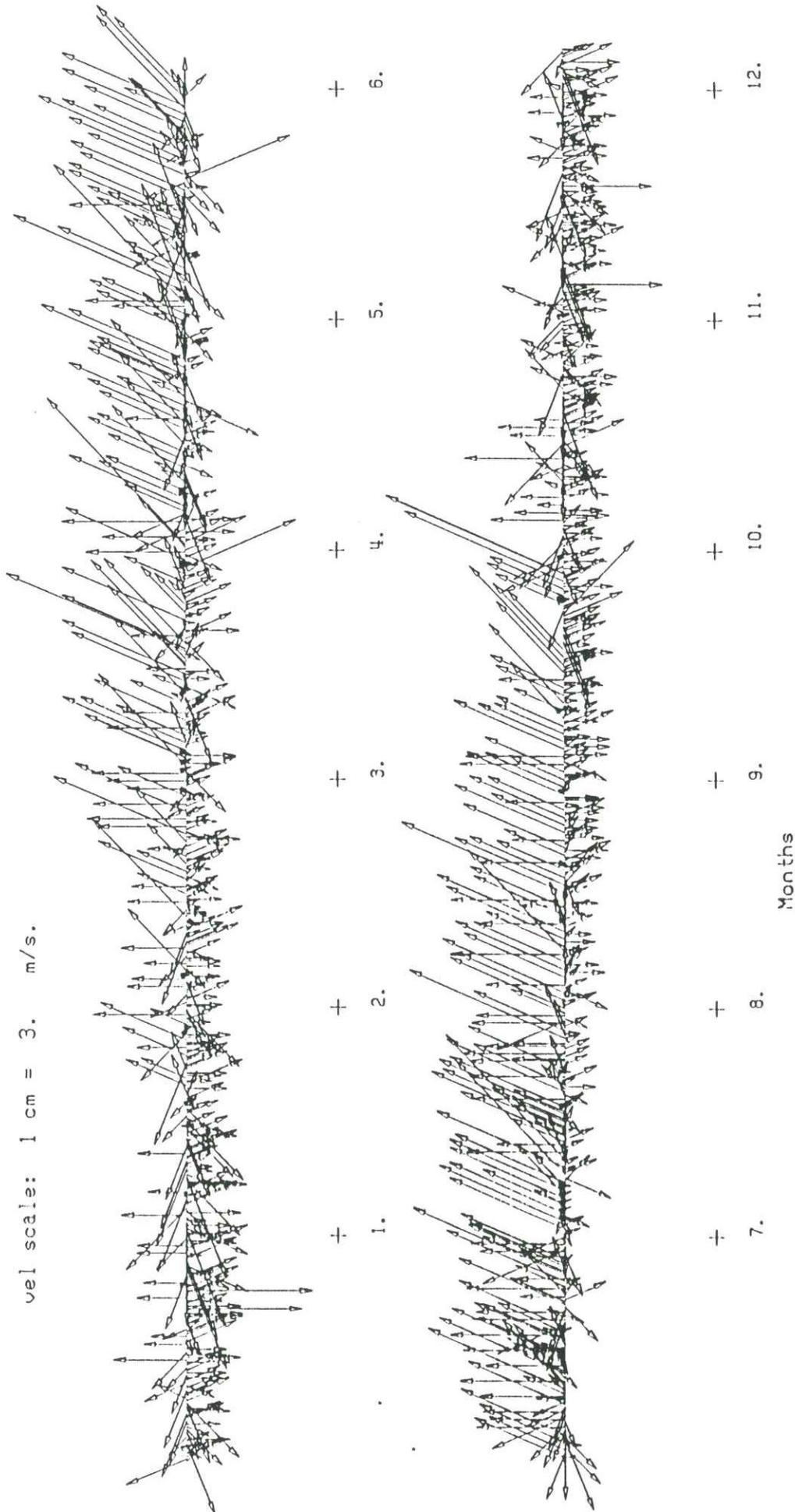


Fig.I.41 Mersin wind velocity vector 1990

Mersin wind velocity vector 1991

vel scale: 1 cm = 3. m/s.

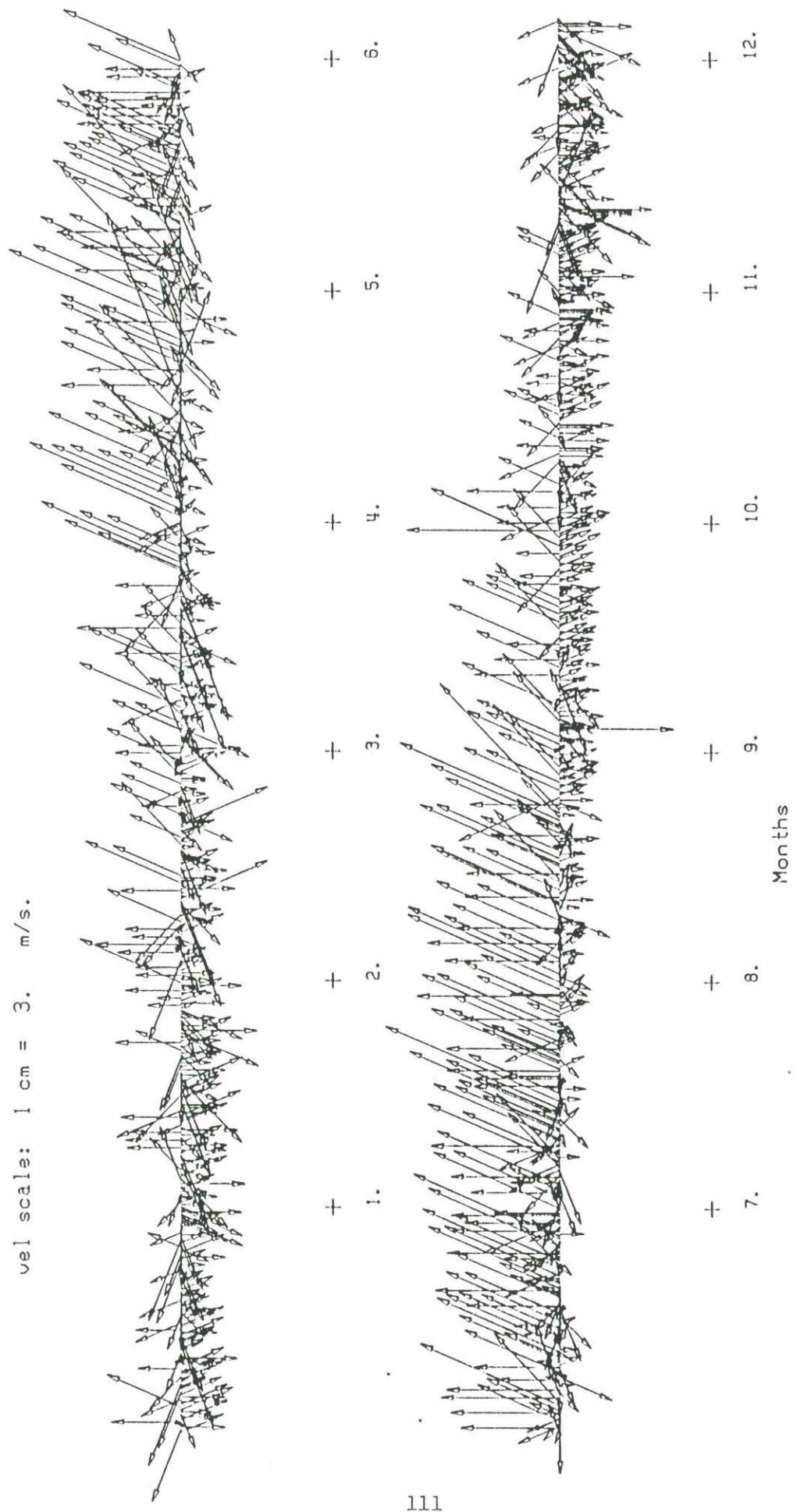
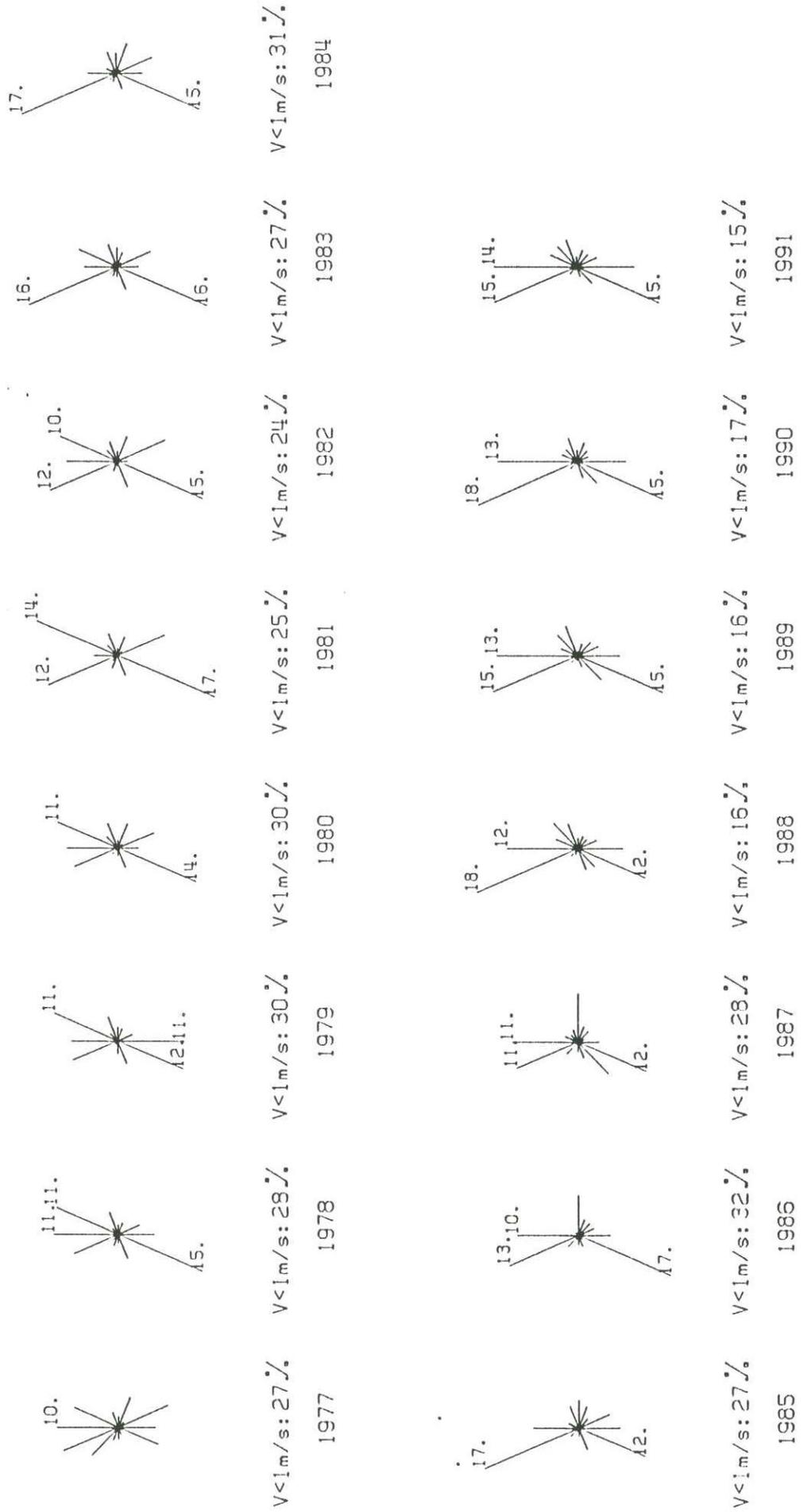
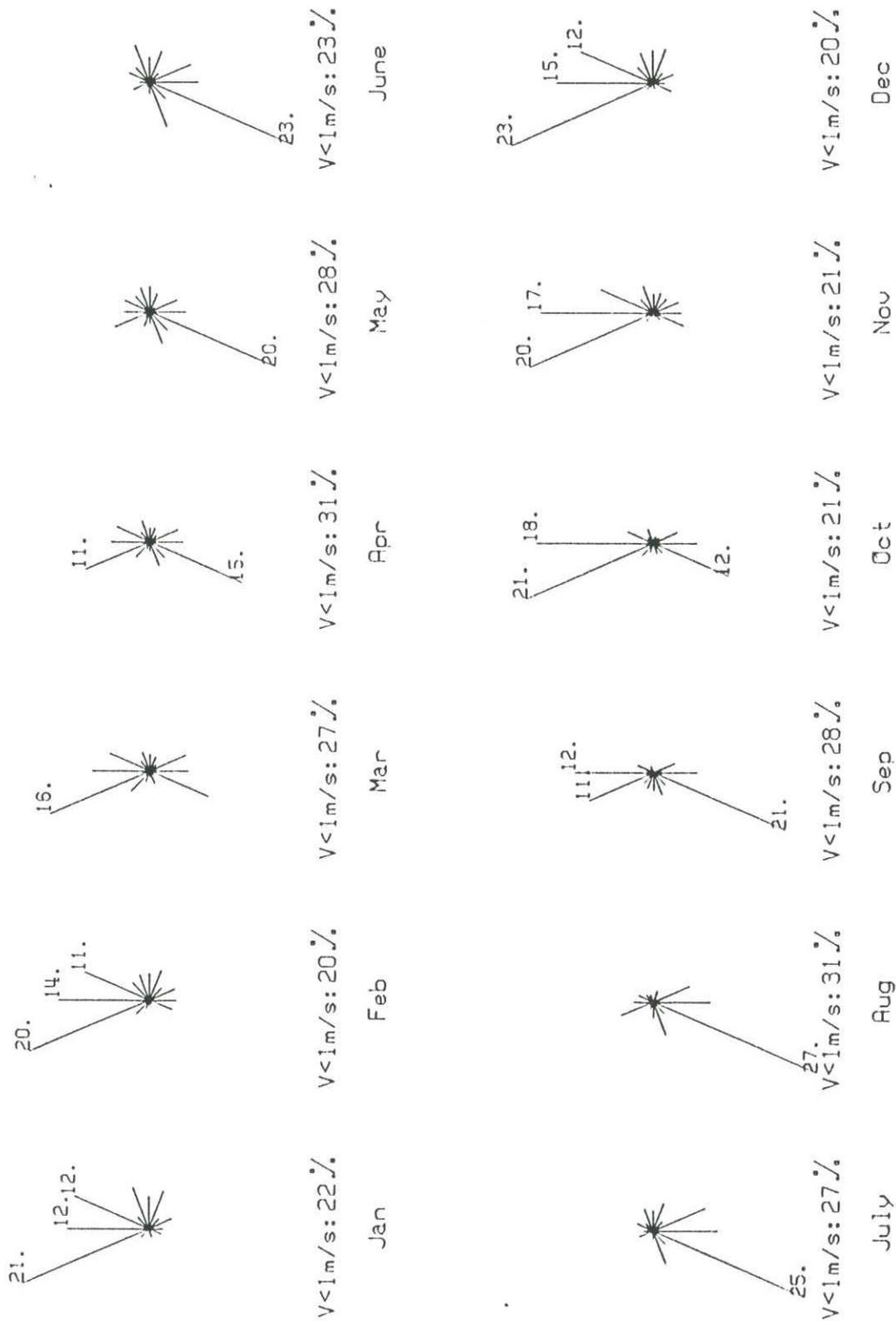


Fig.I.42 Mersin wind velocity vector 1991



Annual wind frequency 1977-1991

Fig.I.43 Wind frequency



Monthly average wind frequency 1977-1991

Fig. I.44 Wind frequency

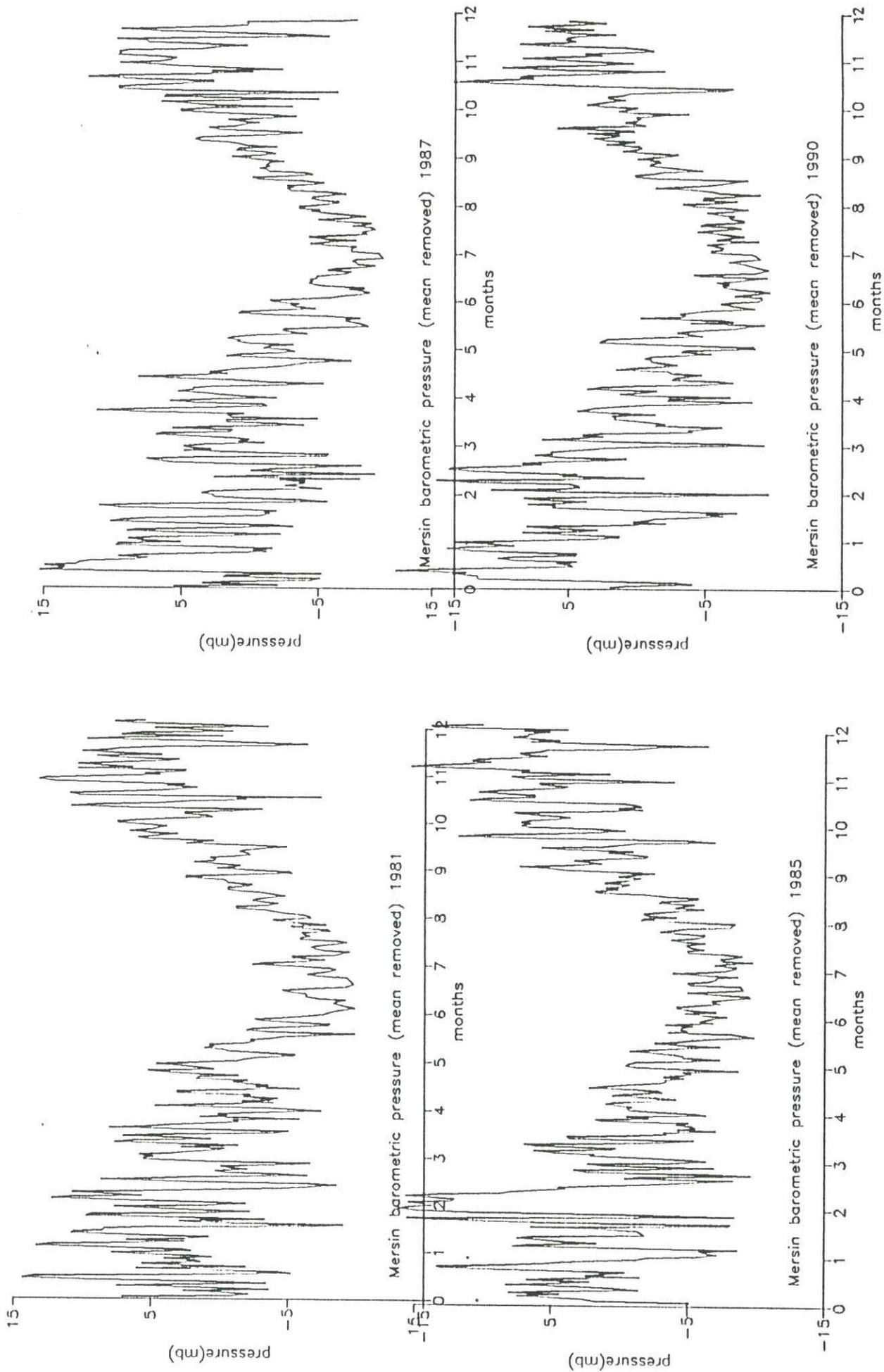


Fig.I.45 Barometric pressure

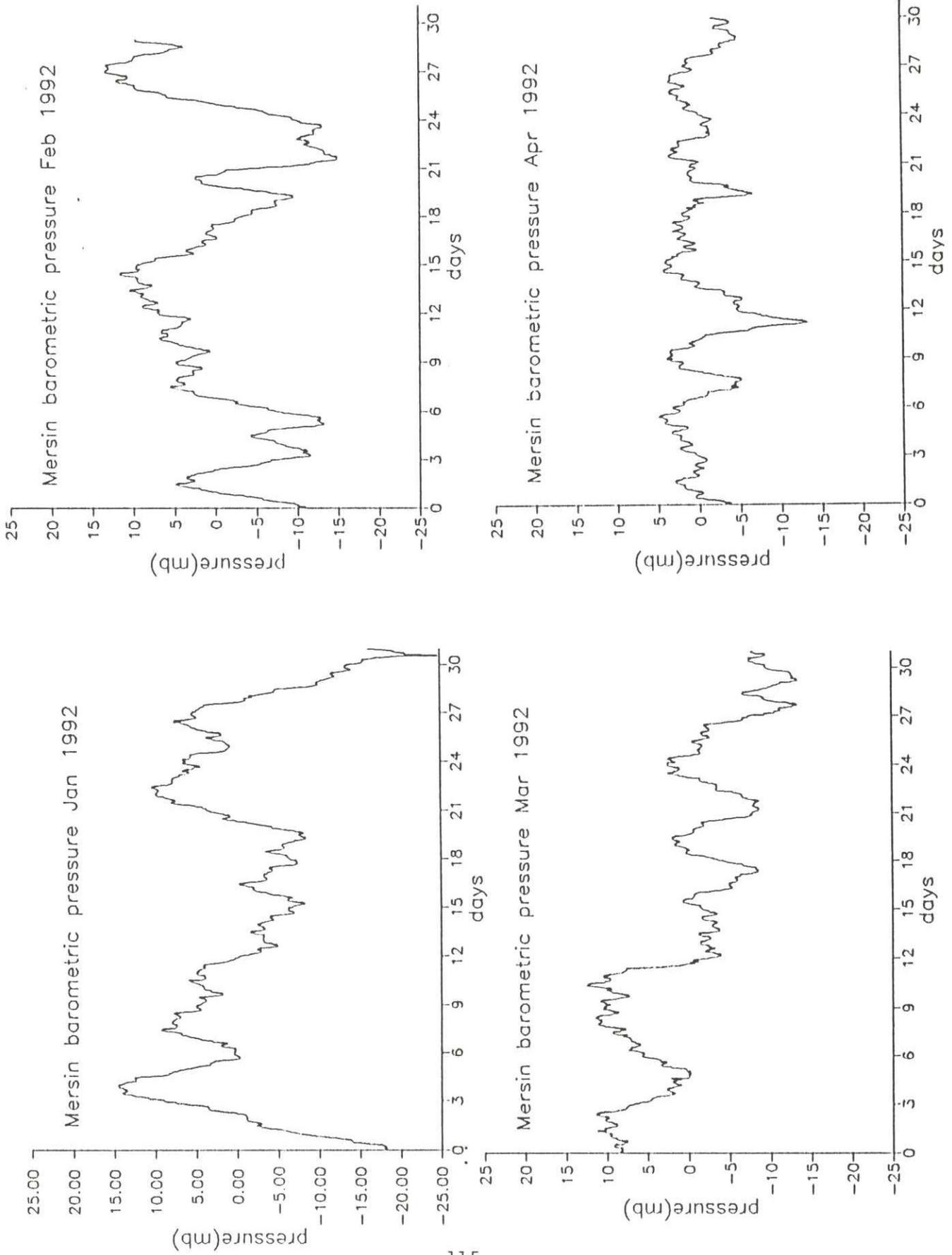


Fig.I.46 Barometric pressure

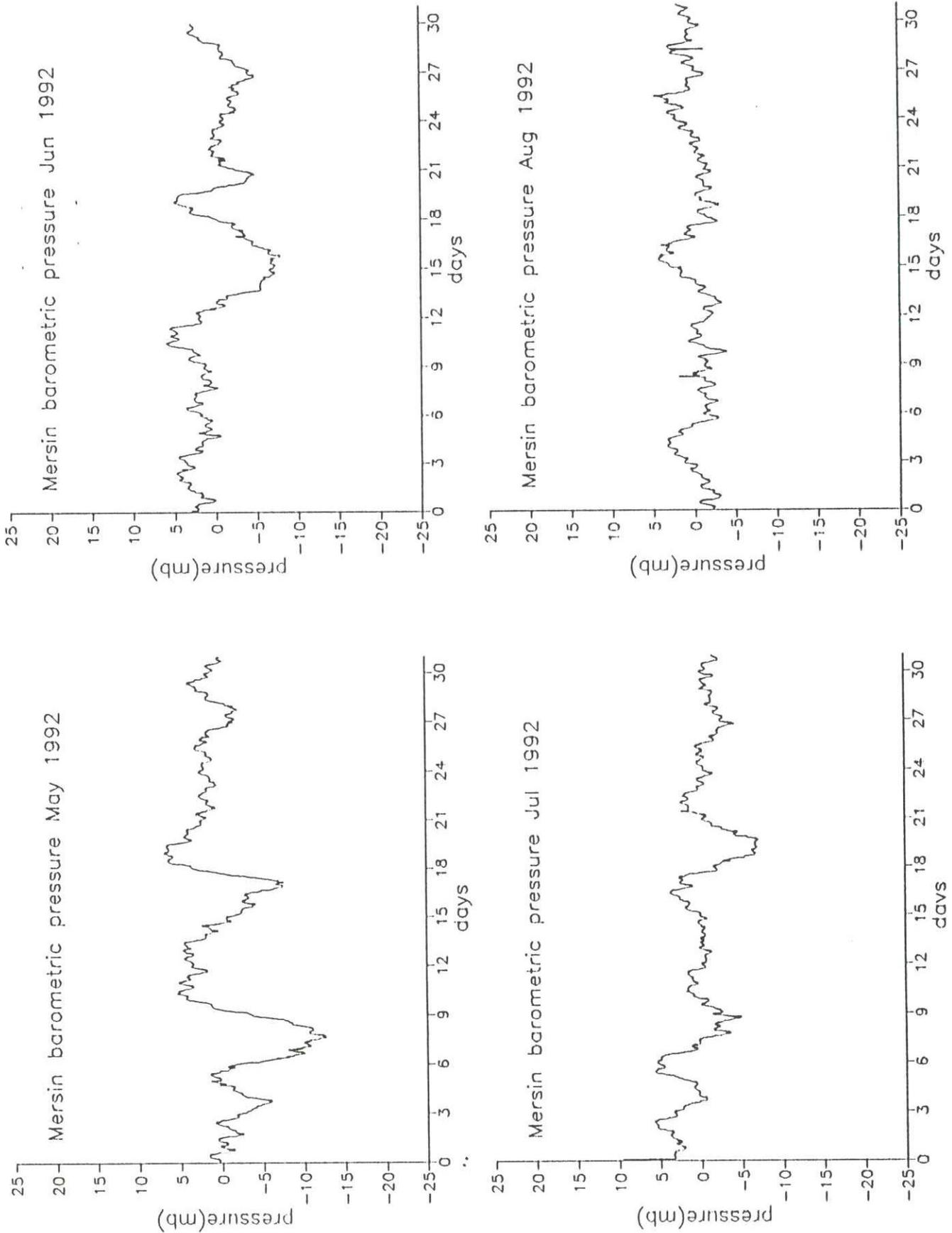


Fig.I.46 Barometric pressure (cont)

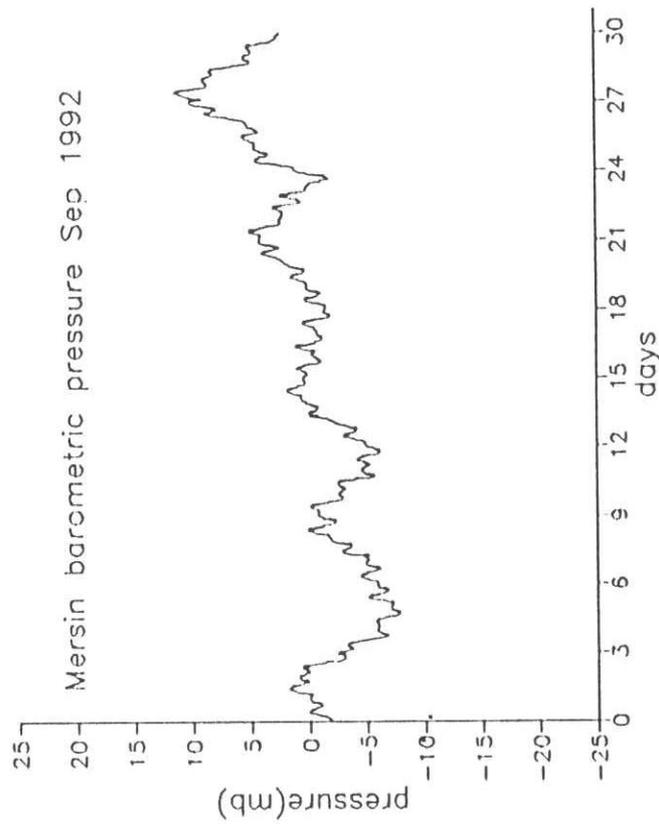
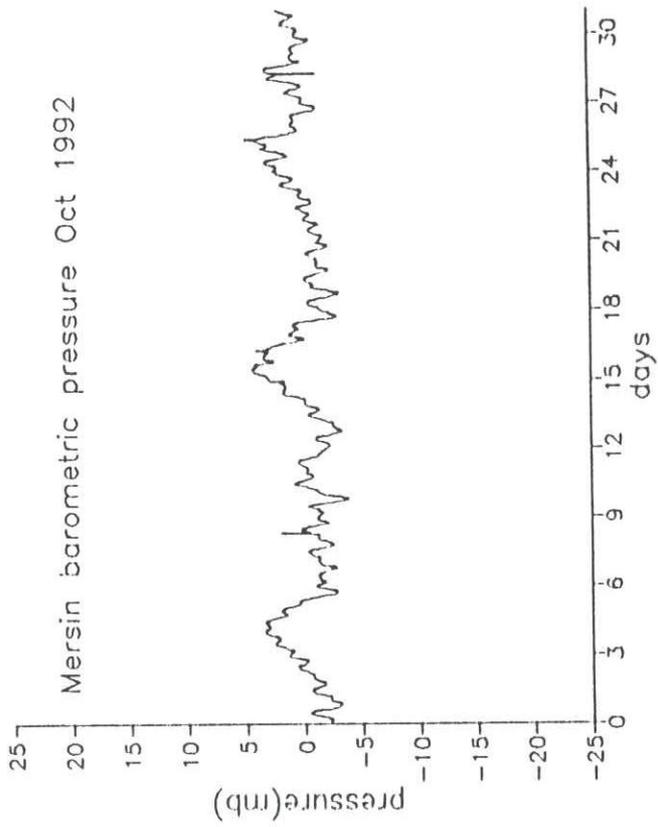


Fig.I.46 Barometric pressure (cont)

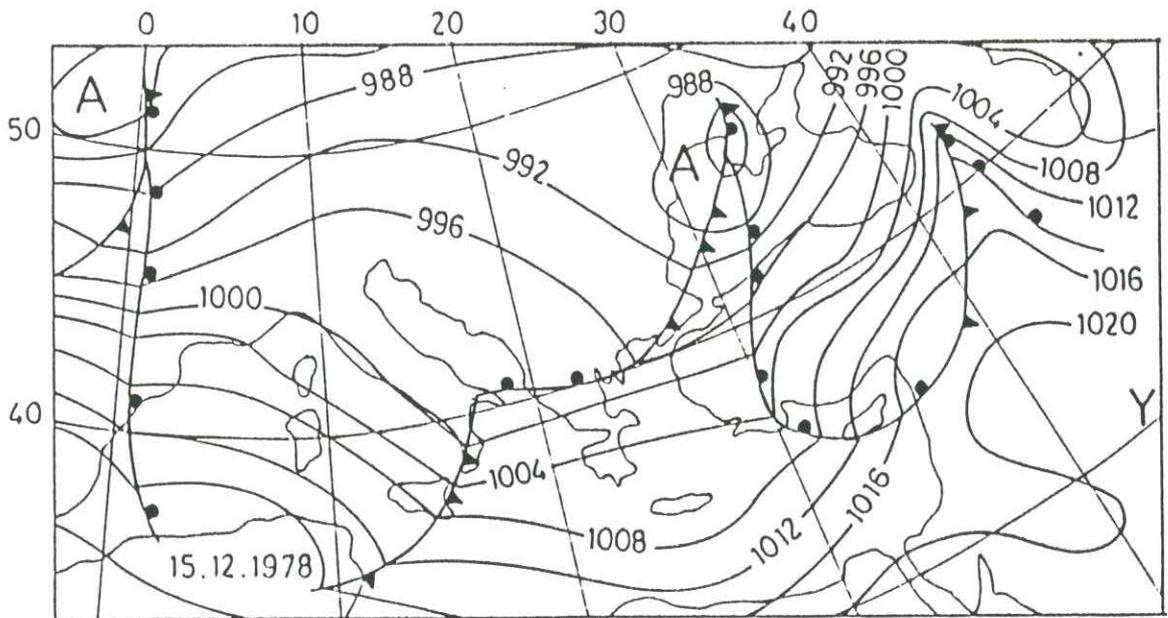


Fig.I.47(a) Surface synoptic map, 15 Dec 1978

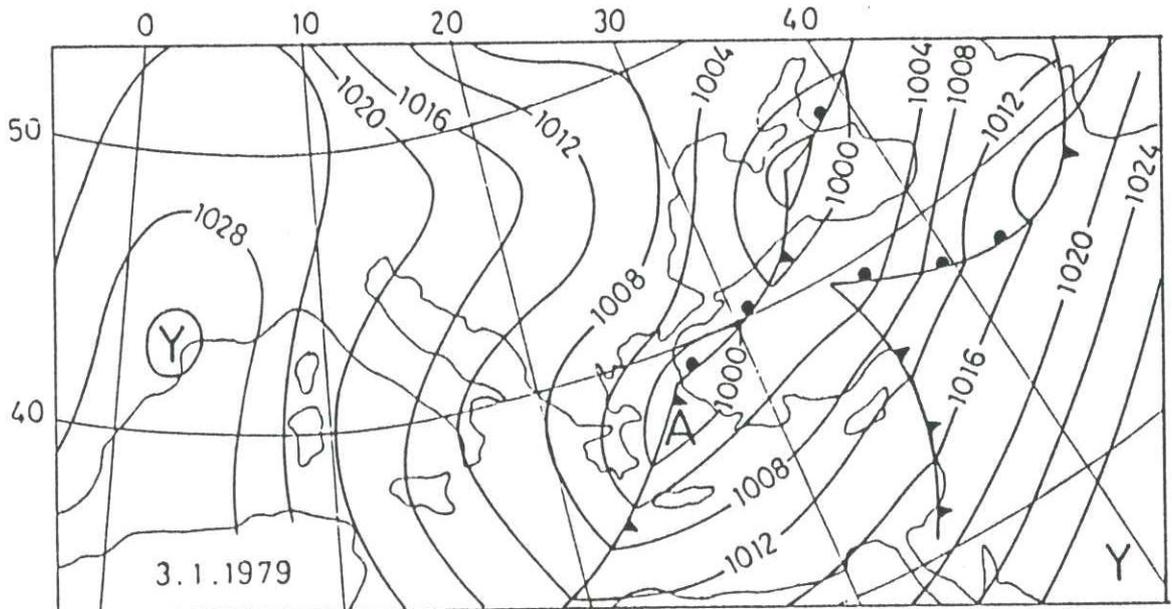


Fig.I.47(b) Surface synoptic map, 3 Jan 1979

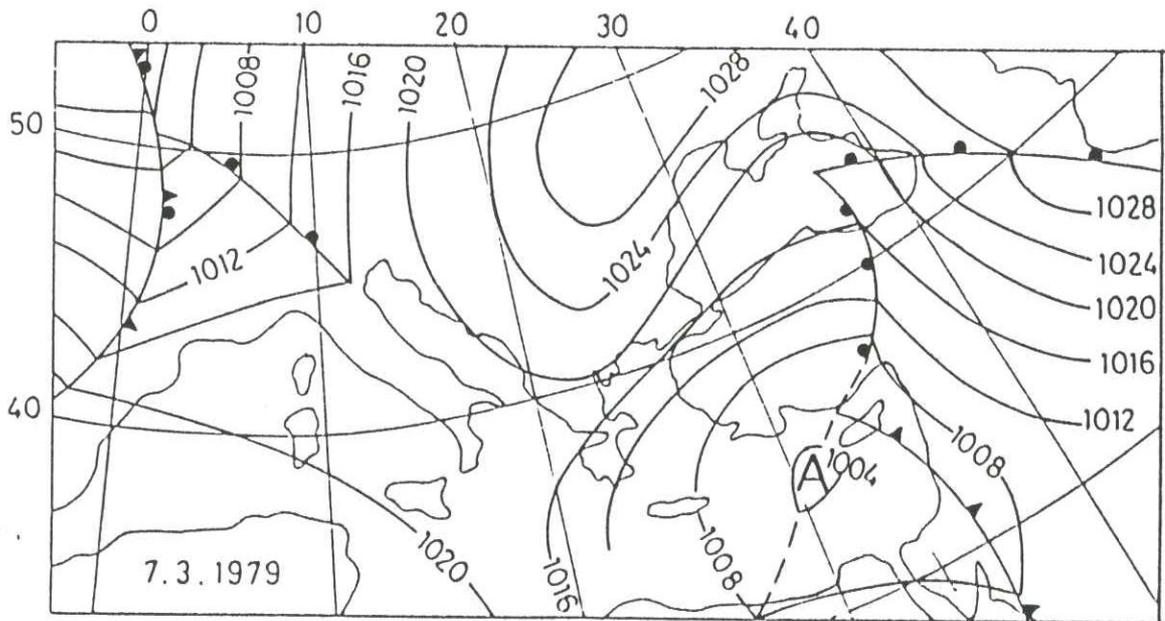


Fig.I.47(c) Surface synoptic map, 7 Mar 1979

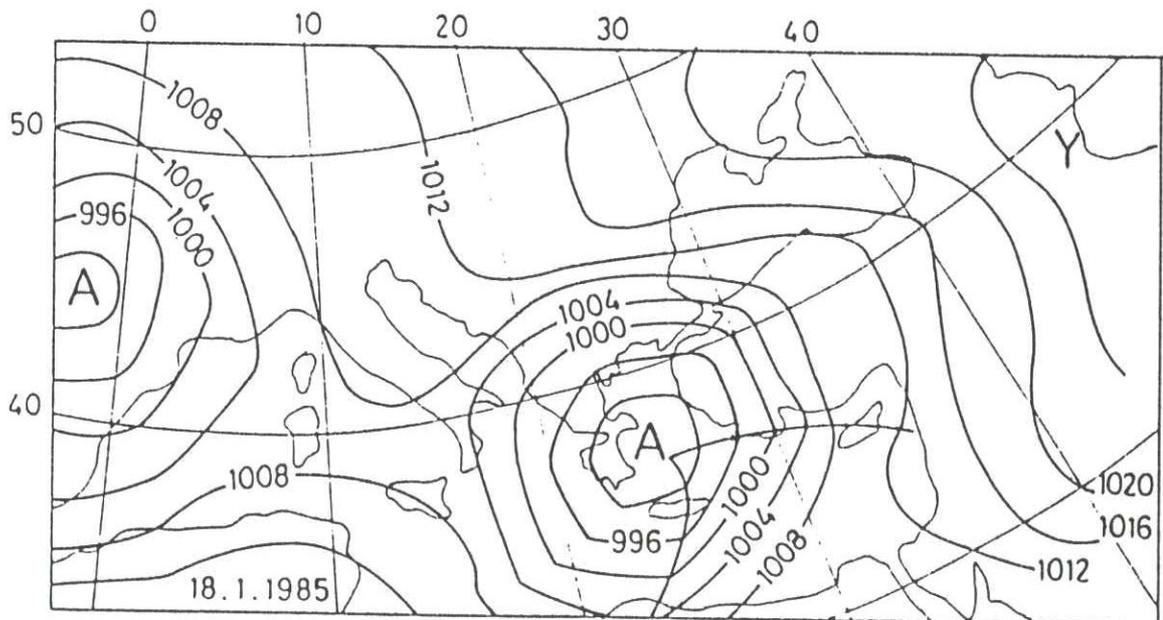


Fig.I.47(d) Surface synoptic map, 18 Jan 1985

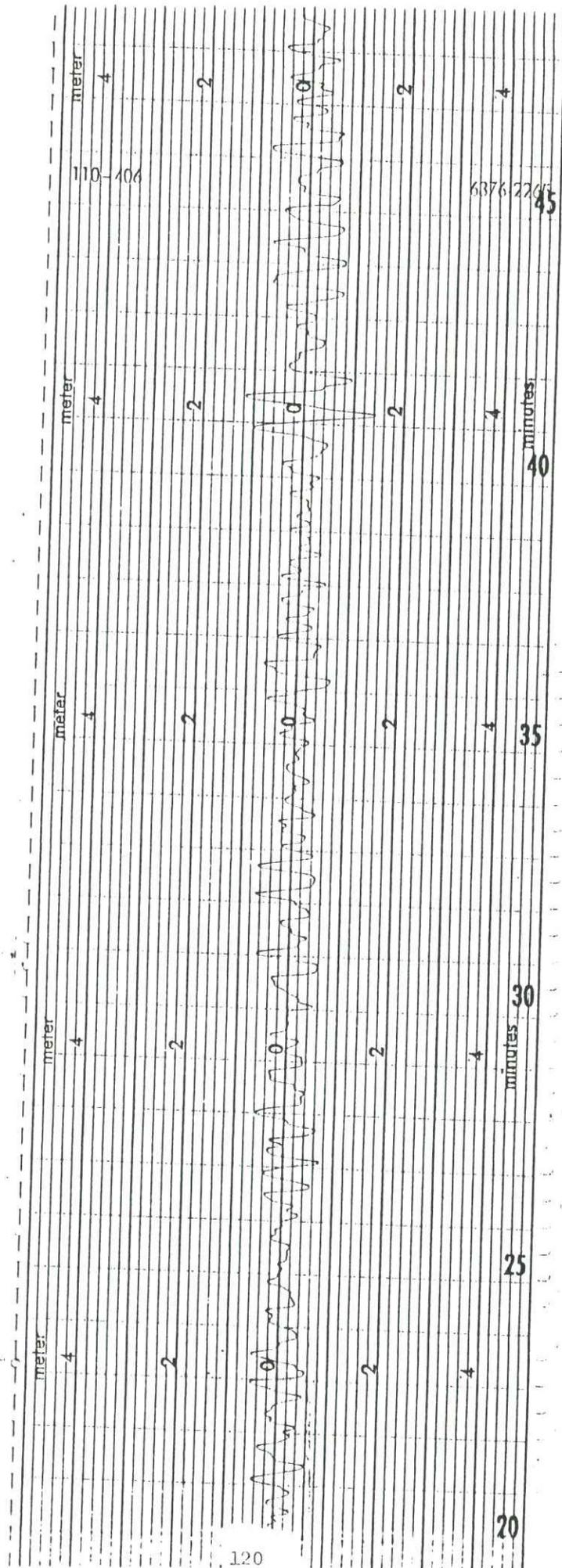


Fig. I.48 (a) Wave record, 15 Dec 1978

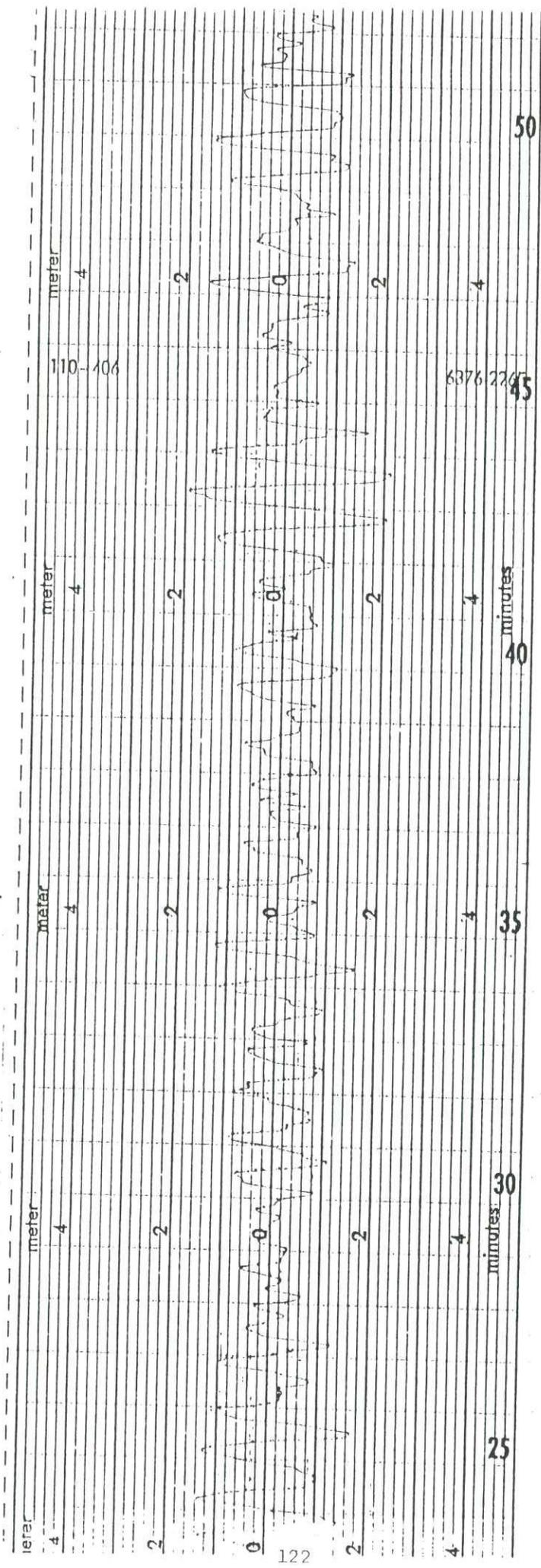
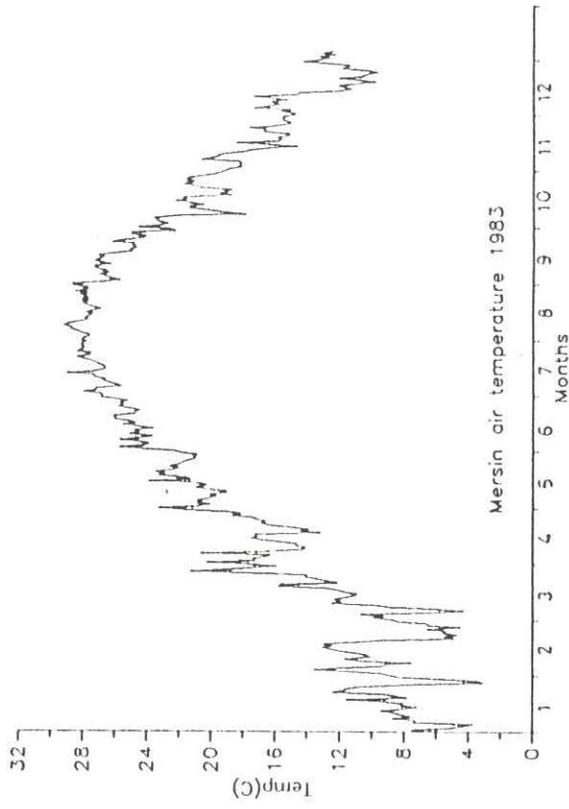
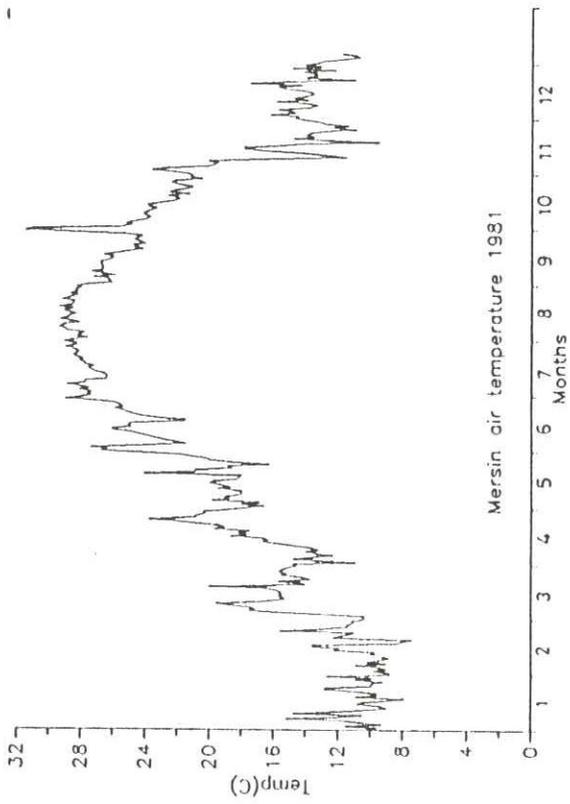


Fig. I.48 (c) Wave record, 7 Mar 1979



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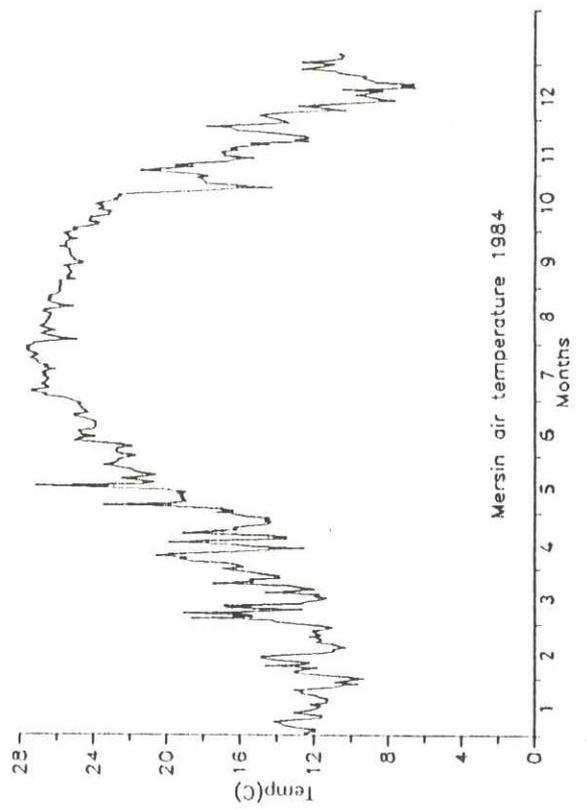
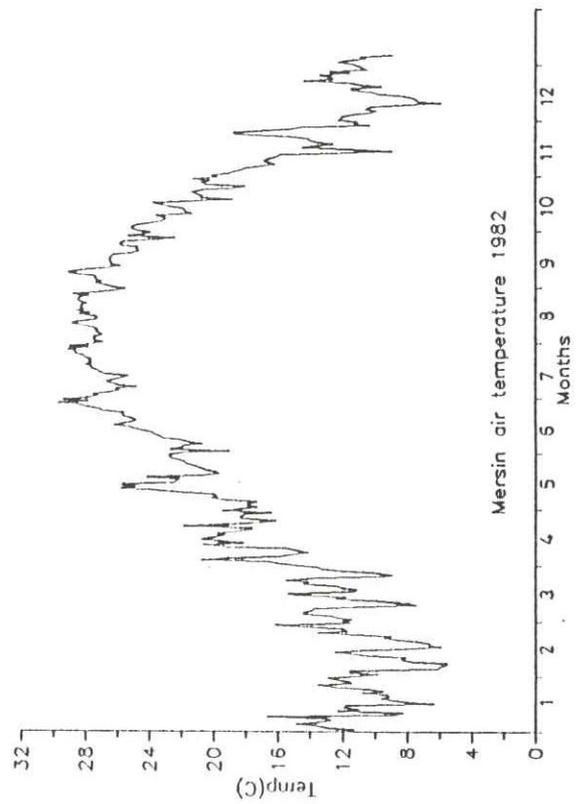


Fig.I.49 Air temperature

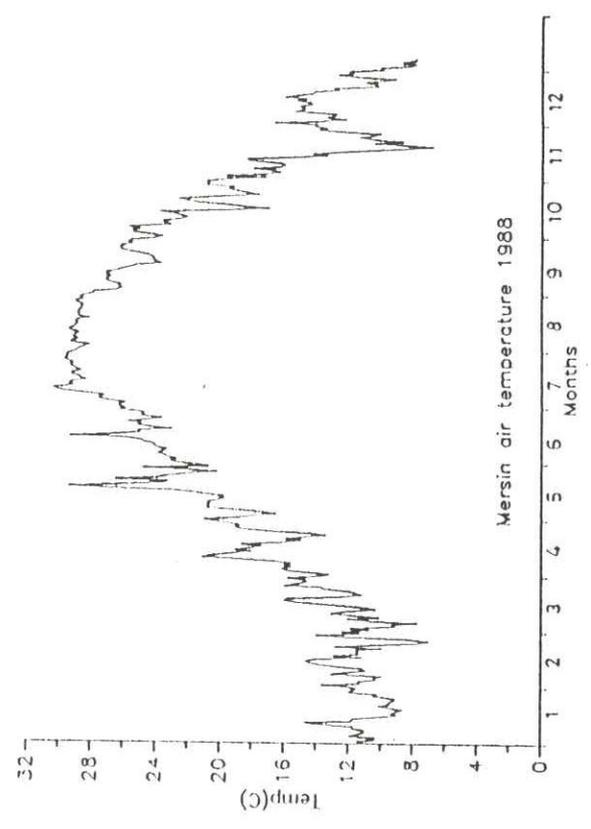
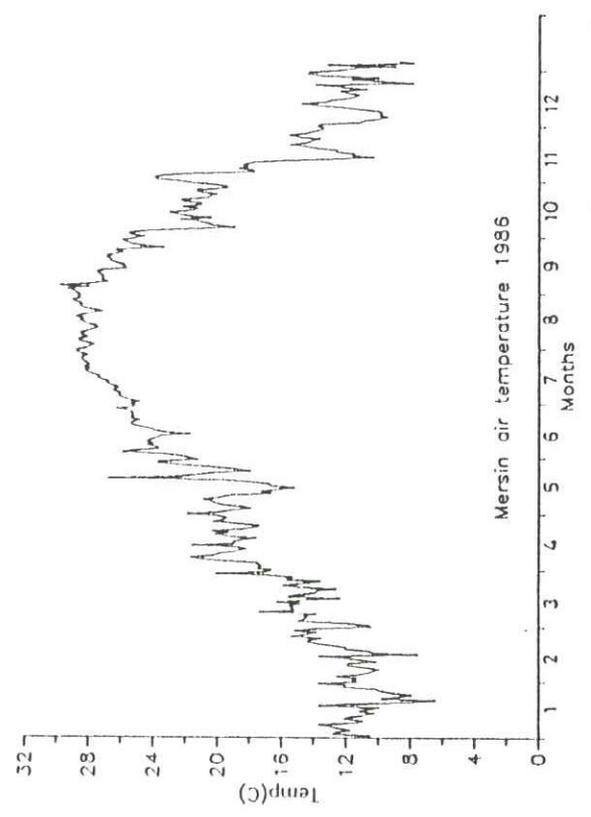
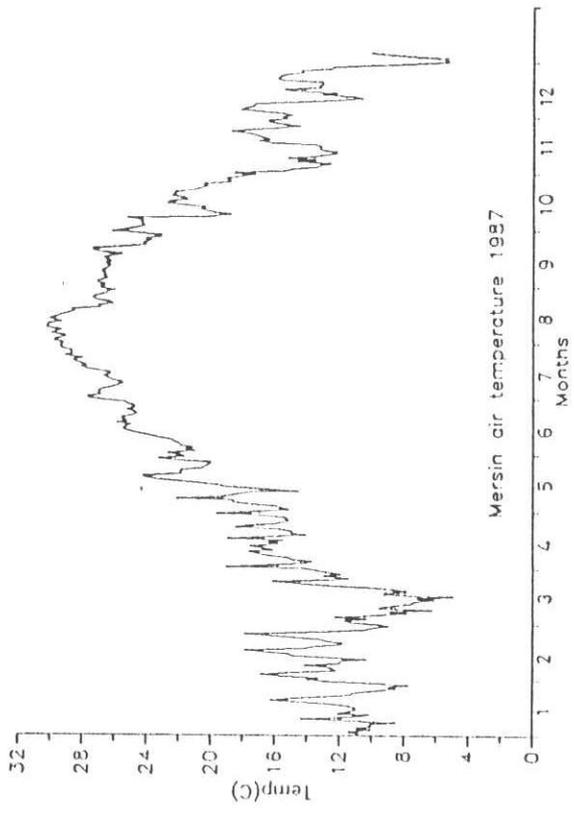
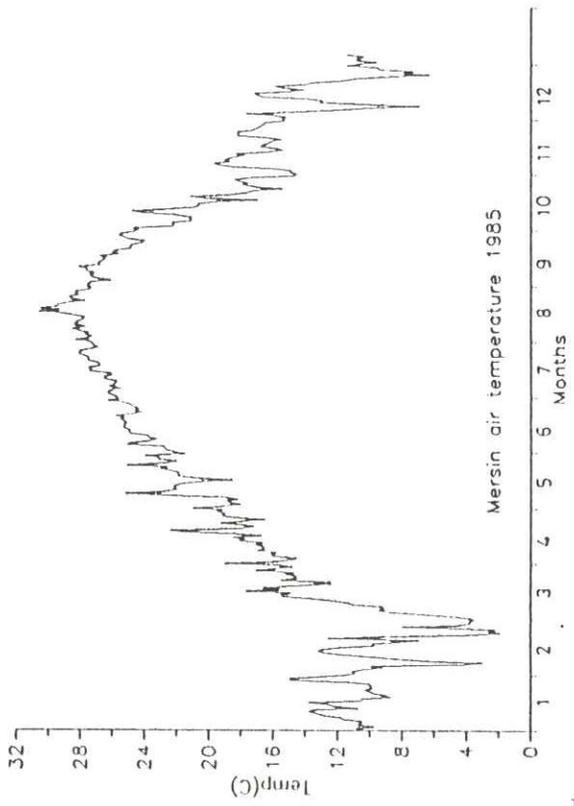


Fig.I.49 Air temperature (cont)

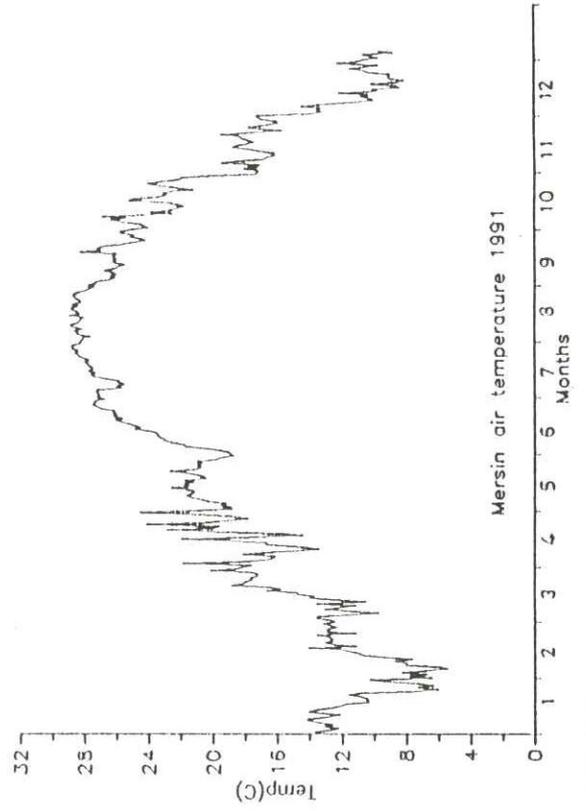
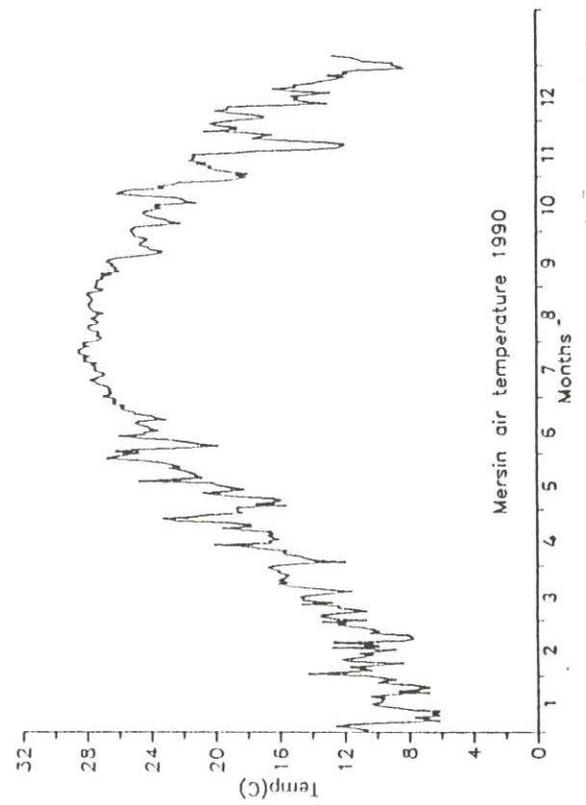
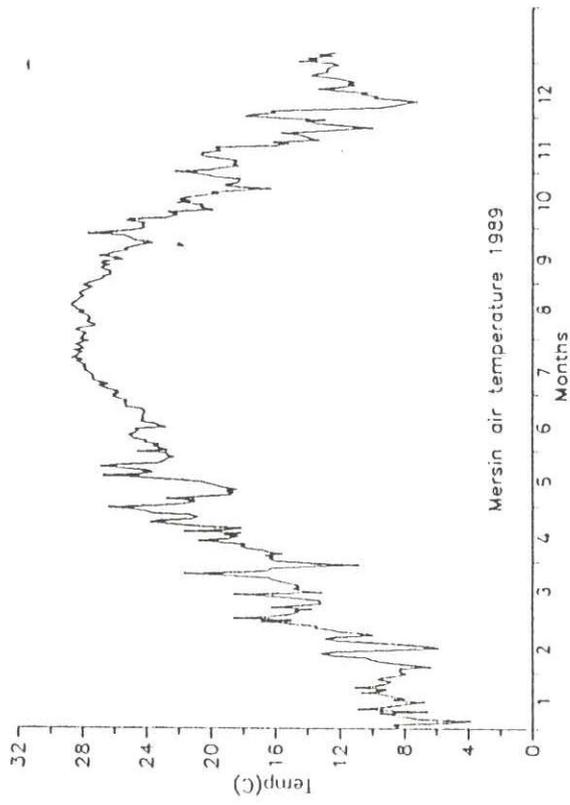


Fig.I.49 Air temperature (cont)

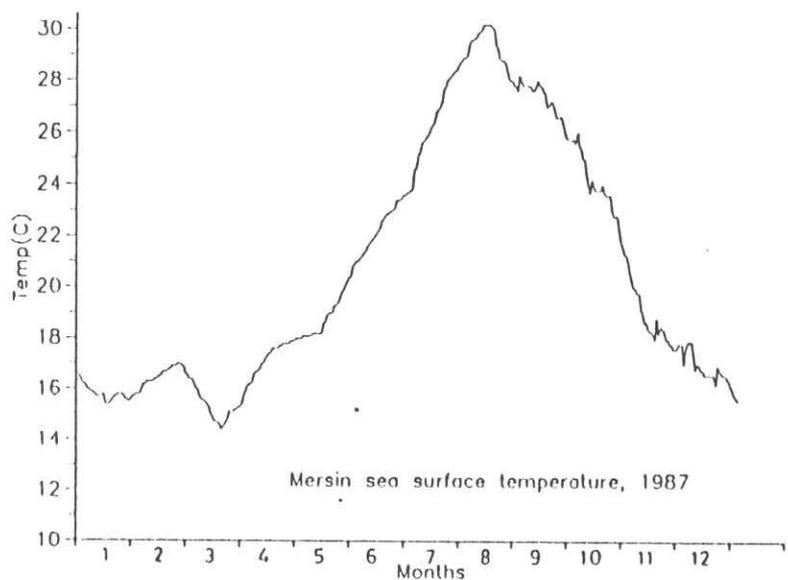
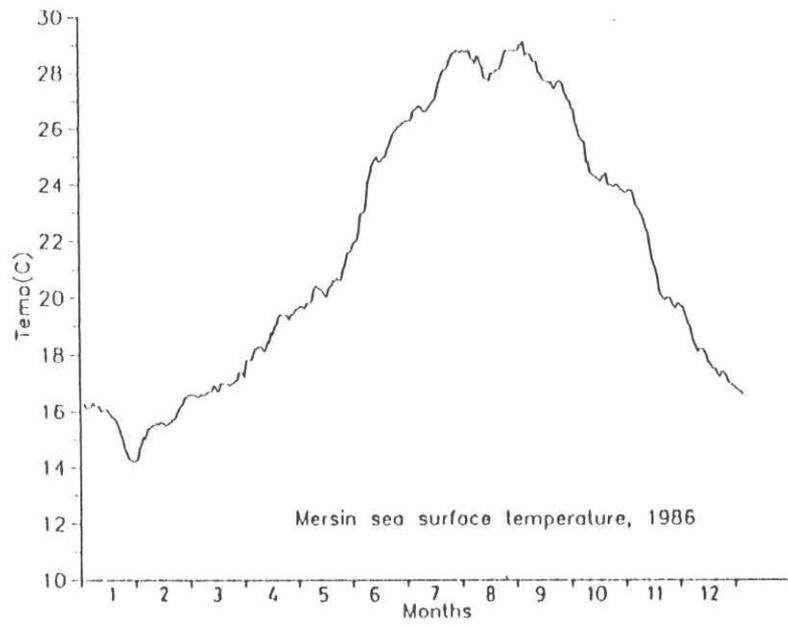
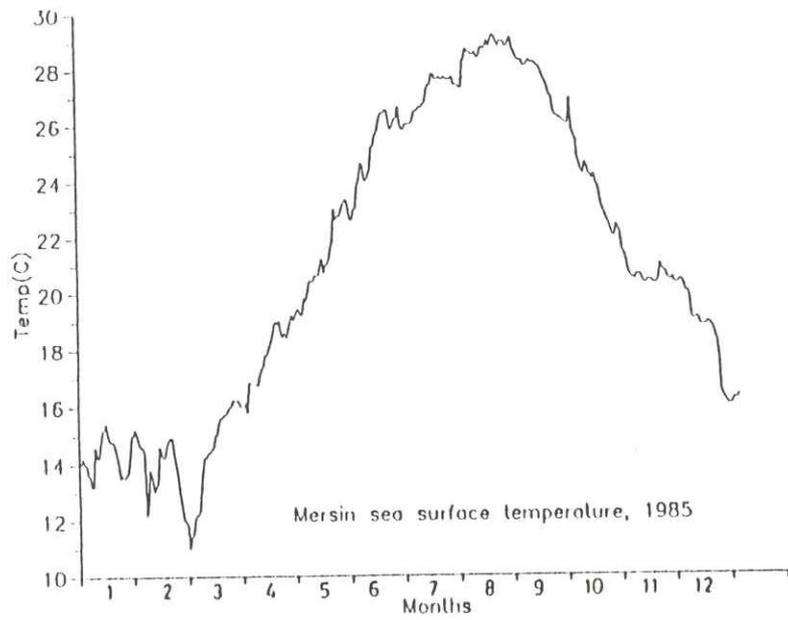


Fig.I.50 Sea surface temperature

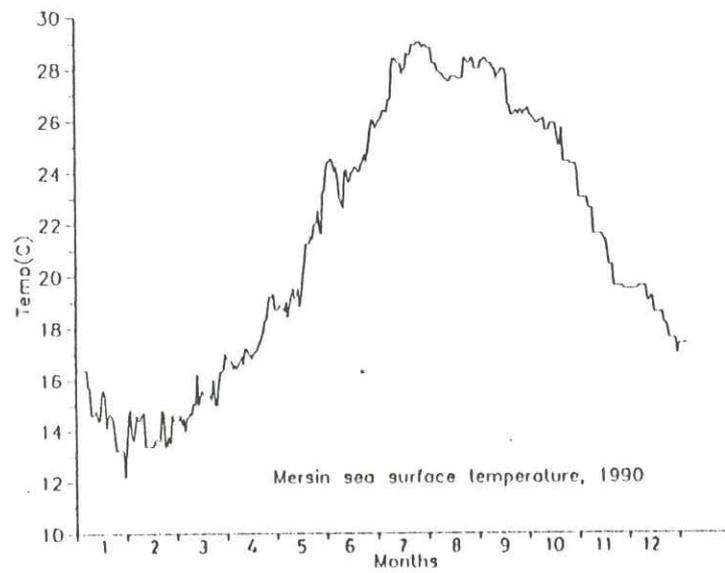
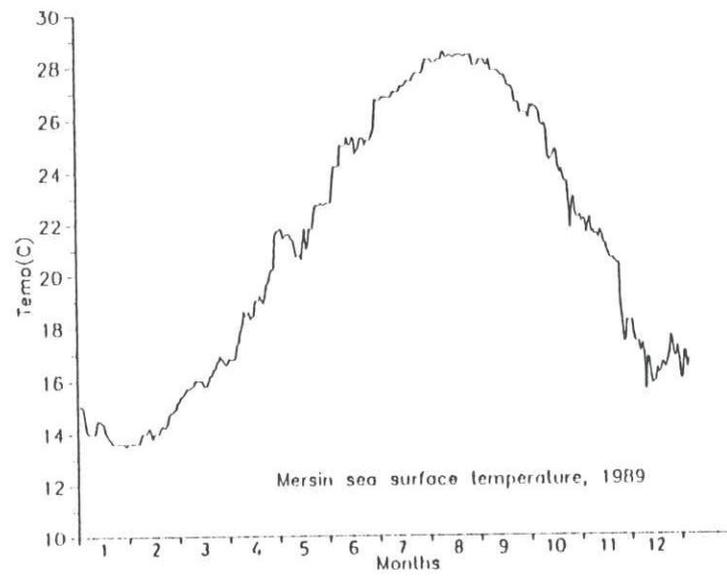
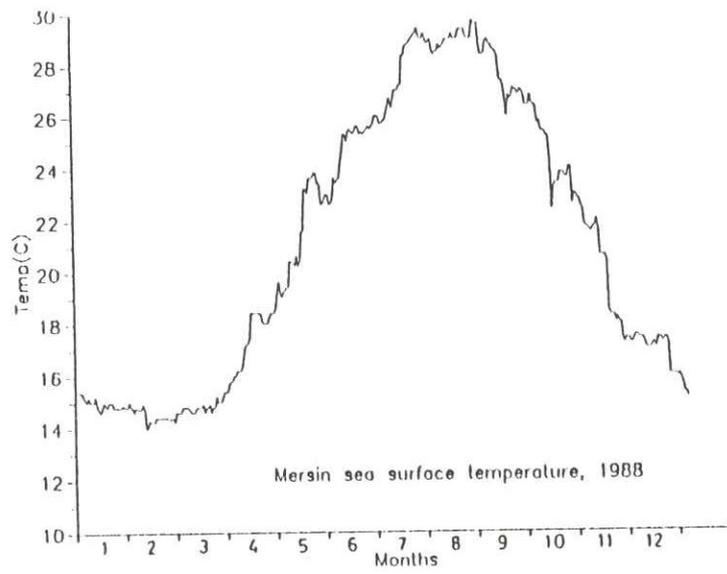
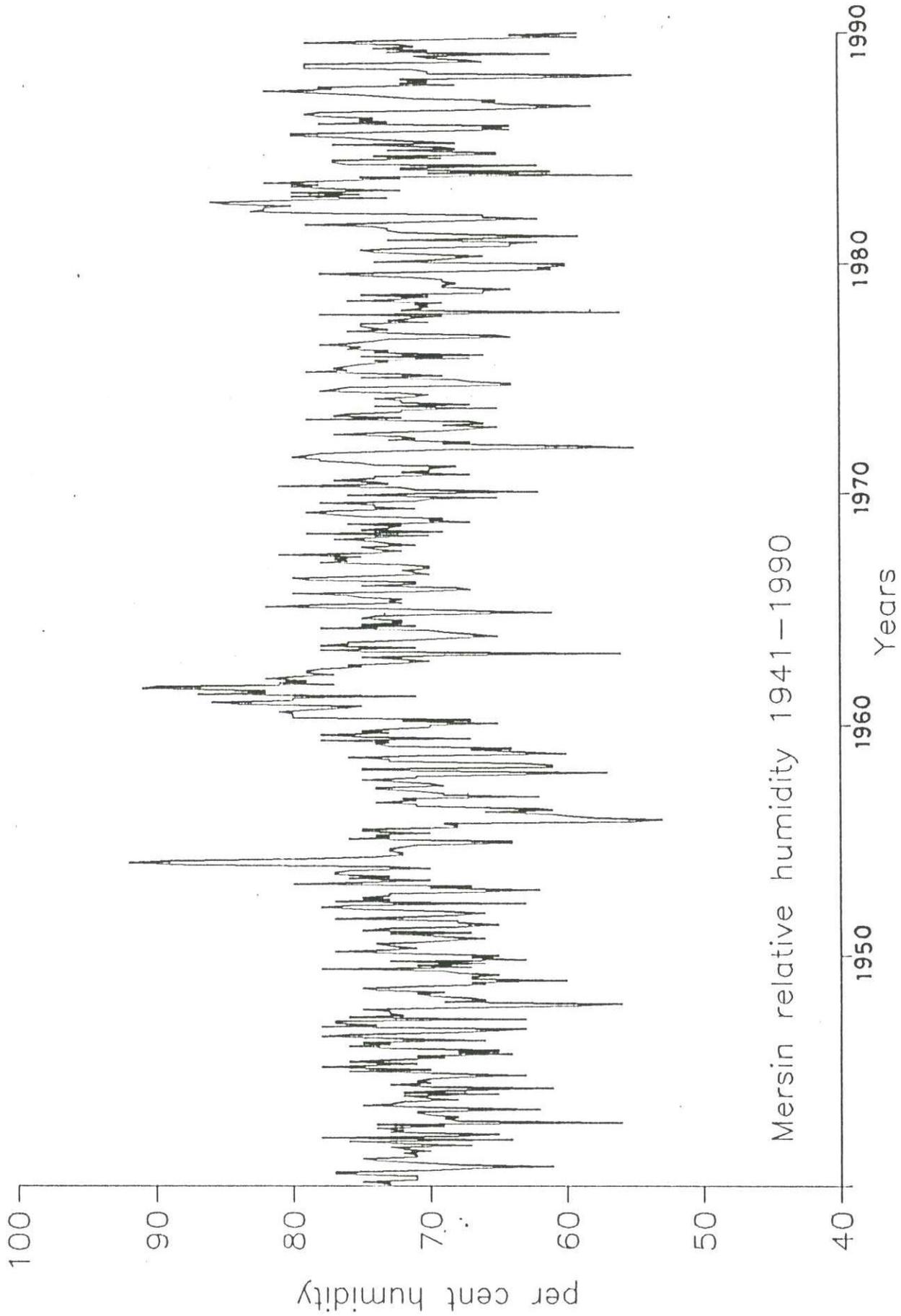


Fig.I.50 Sea surface temperature (cont)



Mersin relative humidity 1941-1990

Fig. I.51 Relative humidity

Table I.1.

Mersin Wind Gust Data, 1992

Wind speeds greater than 10 m/s are listed below.

Date	Speed	Direction	Date	Speed	Direction
27.1.92	11.4	ENE	8.4.92	15.0	W
30.1.92	11.9	NE	12.4.92	20.7	SSW
27.1.92	10.2	ENE	13.4.92	17.7	SSW
3.2.92	12.5	ENE	20.4.92	21.4	SSW
9.2.92	14.9	ENE	21.4.92	11.7	SSW
20.2.92	18.8	SSW	5.5.92	10.9	NE
22.2.92	12.2	NE	7.5.92	14.2	NE
29.2.92	14.8	ENE	8.5.92	12.2	ENE
13.3.92	11.4	NNE	17.5.92	10.7	WSW
15.3.92	10.8	SW	18.5.92	12.5	WSW
18.3.92	12.8	SSW	5.6.92	19.7	NNW
19.3.92	12.0	WNW	19.6.92	11.0	SSW
21.3.92	14.9	SW	29.6.92	12.0	SW
22.3.92	11.8	NW	1.7.92	11.7	SSW
28.3.92	12.7	NE	2.7.92	10.2	SSW
29.3.92	14.6	SSW	19.8.92	11.0	SW
30.3.92	19.3	W	23.8.92	10.1	SSW
31.3.92	11.7	SW	20.9.92	11.2	SW
			5.10.92	6.6	SSW

(For October, maximum observed wind speed is given)

Table I.2.

Mersin monthly average relative humidity(%), 1941-1990

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1941	73	75	71	71	71	77	77	70	67	61	68	71
1942	74	75	71	71	72	70	72	73	67	72	76	64
1943	78	68	65	73	72	74	69	74	56	68	69	68
1944	70	71	71	62	69	75	73	72	68	70	72	65
1945	72	69	61	70	73	70	71	70	68	63	70	76
1946	70	78	75	71	76	73	69	71	64	68	65	73
1947	76	73	75	66	72	78	76	69	65	63	78	74
1948	77	77	63	76	72	73	73	75	68	59	56	69
1949	66	67	70	71	69	74	75	71	66	67	60	67
1950	67	65	68	69	78	67	71	66	73	63	67	65
1951	70	77	73	71	73	74	71	68	66	69	73	67
1952	75	73	68	65	68	68	77	72	68	66	69	75
1953	78	76	63	77	73	75	73	73	66	62	70	67
1954	80	75	70	76	73	77	77	76	70	73	88	92
1955	89	79	74	72	72	73	73	72	71	64	64	76
1956	73	74	70	75	75	68	68	69	55	53	58	60
1957	61	66	61	62	71	71	74	71	72	62	69	69
1958	71	74	74	69	70	72	75	71	71	63	57	75
1959	75	61	61	63	73	73	76	71	60	63	67	64
1960	73	74	73	78	67	75	78	73	75	73	70	70
1961	65	72	67	80	80	80	81	79	76	75	84	86
1962	80	80	71	87	82	82	91	90	77	81	79	82
1963	80	77	79	79	78	75	76	72	70	72	75	69
1964	56	75	78	71	78	76	76	71	68	65	67	69
1965	70	78	71	75	72	72	75	74	70	61	68	73
1966	82	78	72	73	72	75	76	80	71	67	68	75
1967	71	71	79	80	75	70	71	72	70	70	72	78
1968	76	77	75	81	74	72	74	75	71	73	74	77
1969	74	70	79	69	75	73	72	76	67	70	69	75
1970	77	79	77	71	74	74	78	71	70	65	76	71
1971	62	71	72	81	73	74	77	74	74	67	72	70
1972	70	68	74	75	78	78	80	79	78	74	69	55
1973	59	69	67	73	71	72	77	74	69	67	65	69
1974	66	67	79	72	77	76	72	72	65	74	67	72
1975	72	74	71	70	72	78	77	76	64	64	67	68
1976	75	69	72	79	76	77	76	75	73	74	67	75
1977	66	74	73	76	75	78	76	74	73	64	65	71
1978	76	73	74	75	75	70	73	71	69	78	56	72
1979	71	70	71	69	76	72	70	75	66	66	64	69
1980	69	68	69	69	71	75	78	70	61	62	60	60
1981	74	70	68	66	70	74	75	72	64	64	62	73
1982	66	59	67	72	73	73	74	79	73	68	62	66
1983	66	77	83	82	82	80	85	86	80	73	80	75
1984	80	72	76	80	78	82	79	72	75	55	70	61
1985	72	72	62	76	77	77	69	74	65	65	73	68
1986	69	77	68	71	74	76	80	80	72	64	66	64
1987	78	73	75	74	78	79	78	68	62	58	64	66
1988	65	71	73	75	78	82	77	78	68	72	70	72
1989	58	55	70	70	71	79	79	79	66	67	70	71
1990	61	73	70	74	71	72	79	74	67	59	64	59

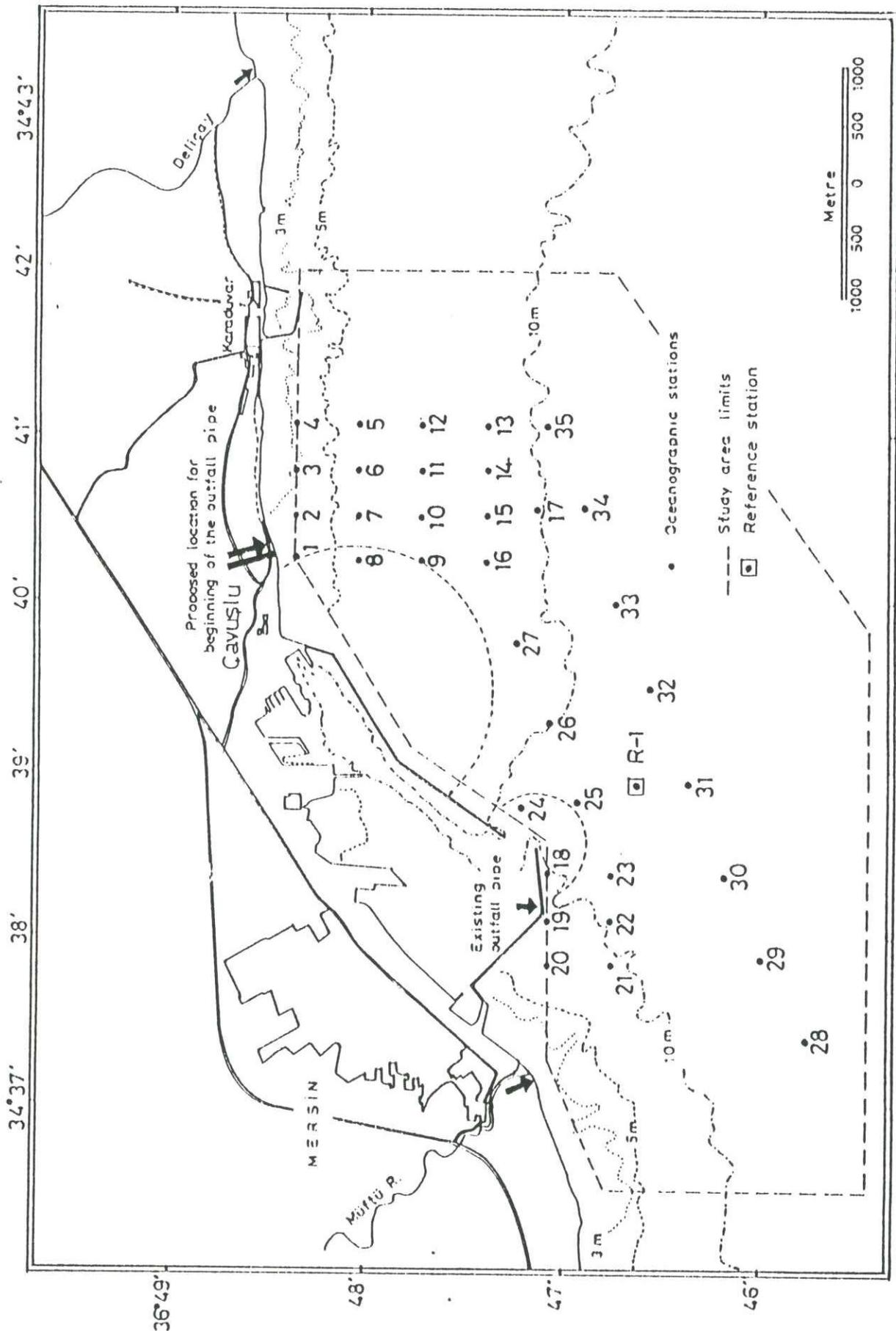


Figure II.1. Station locations in Mersin Bay

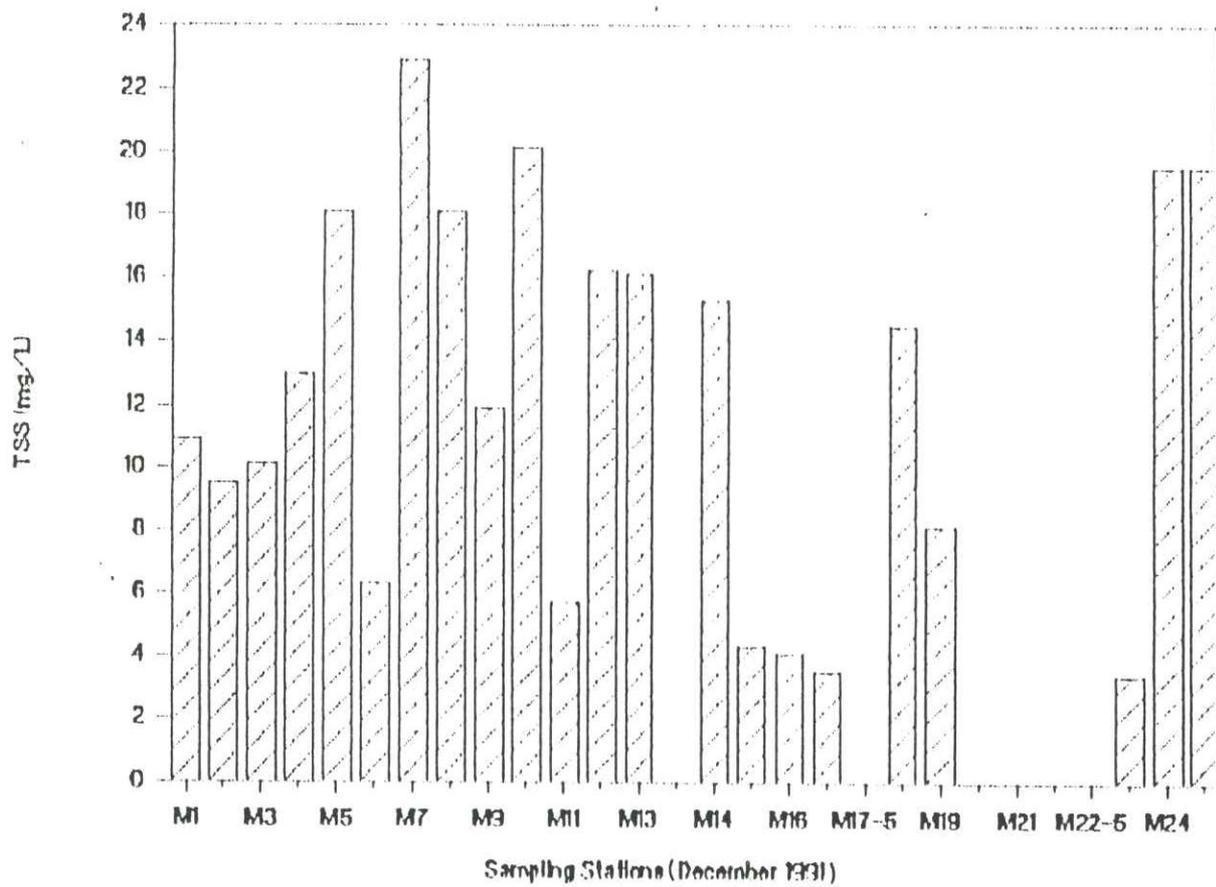


Figure II.2. The seasonal variation of Total Suspended Sediment (TSS, mg/L) in Mersin Bay during December 1991-October 1992.

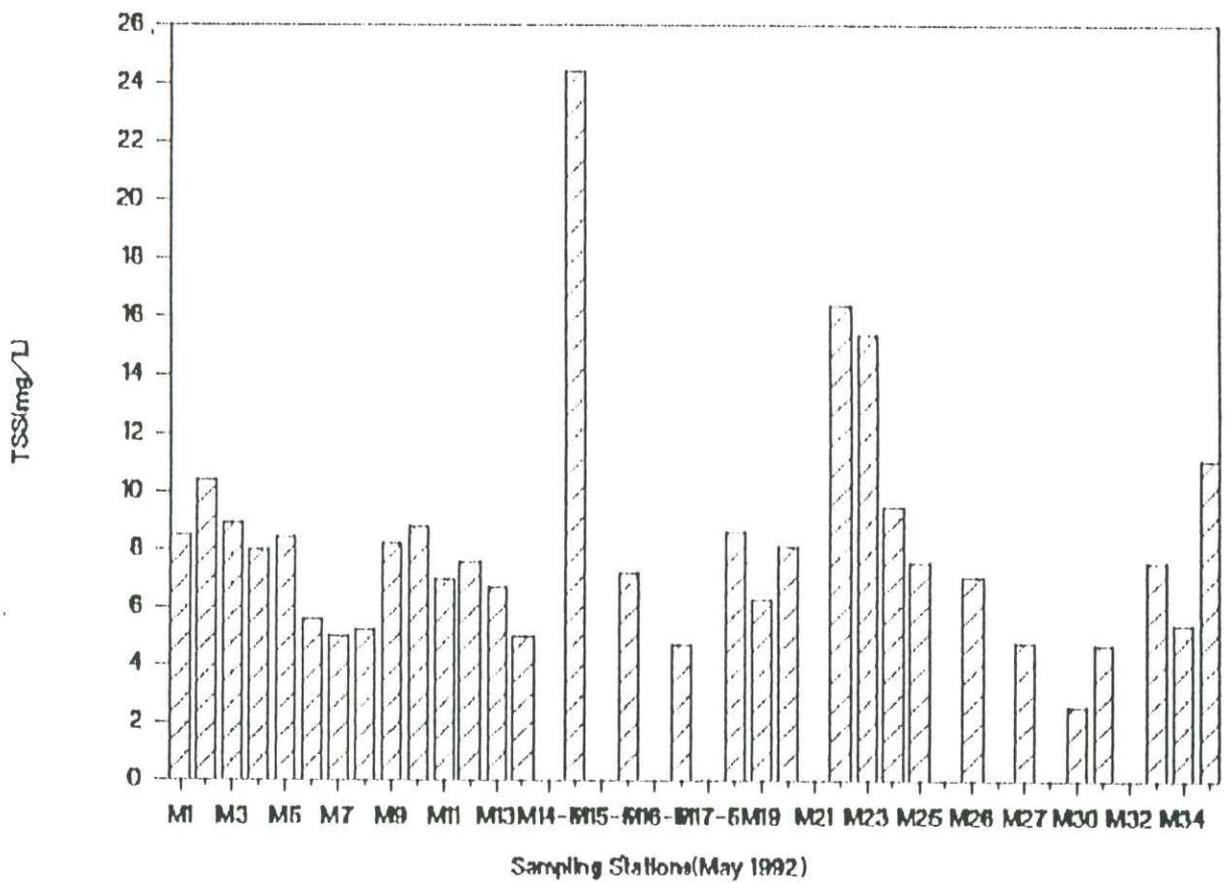
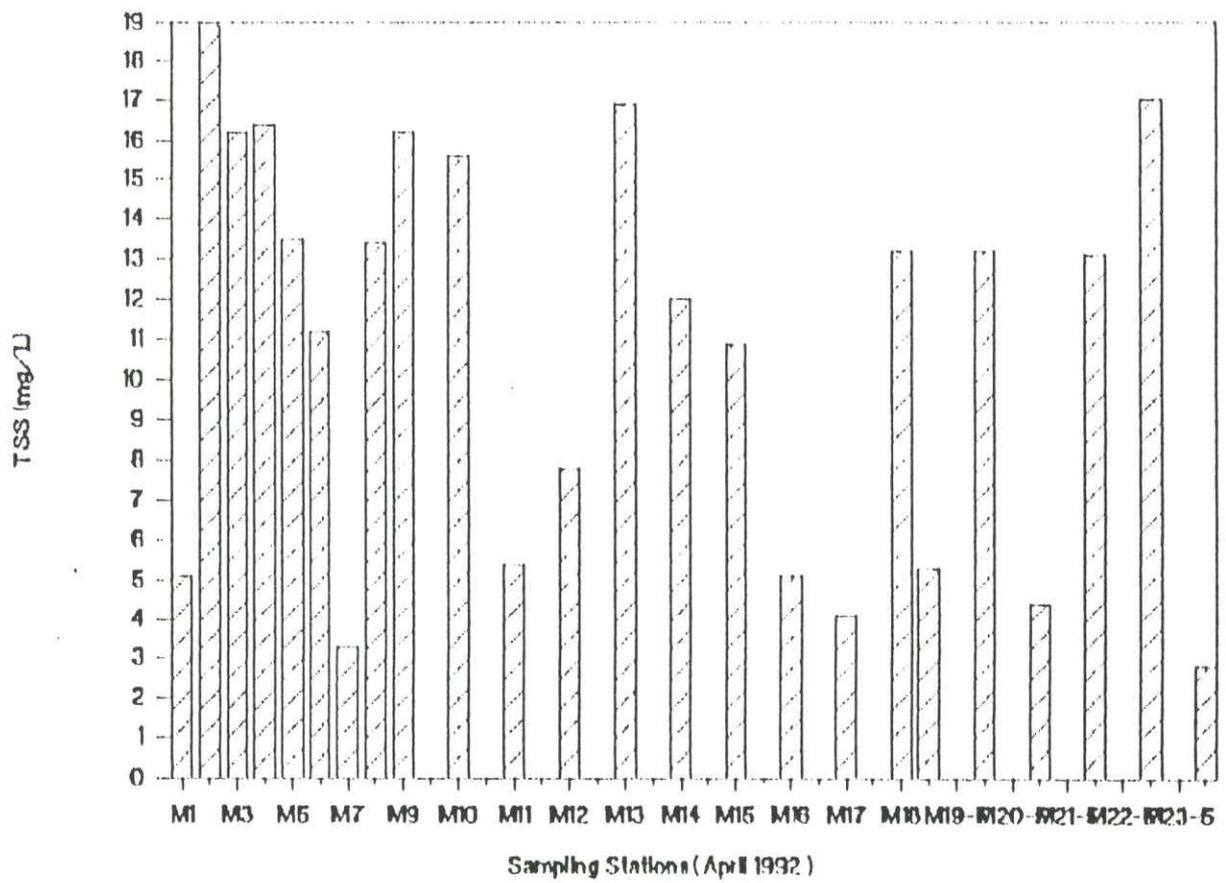


Figure II.2. continued

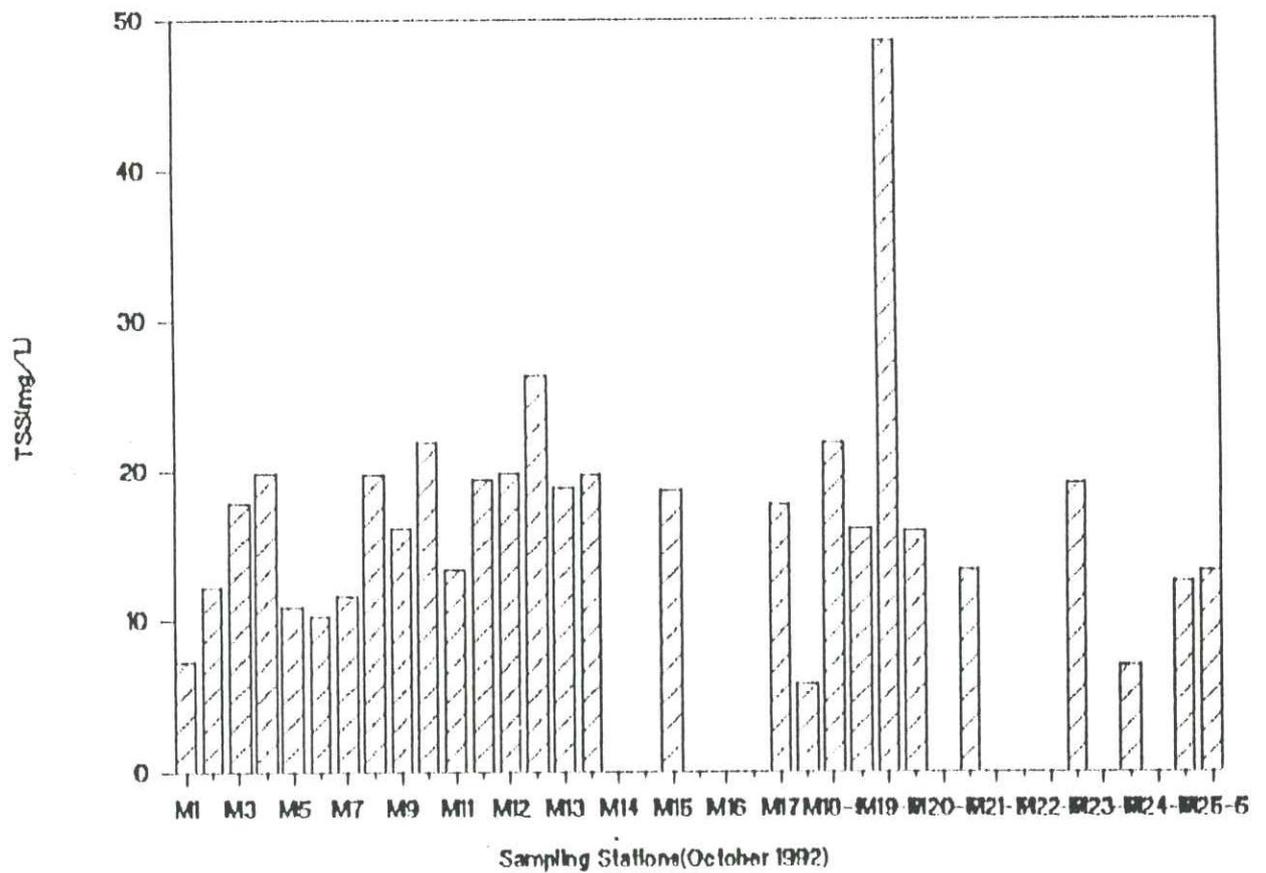
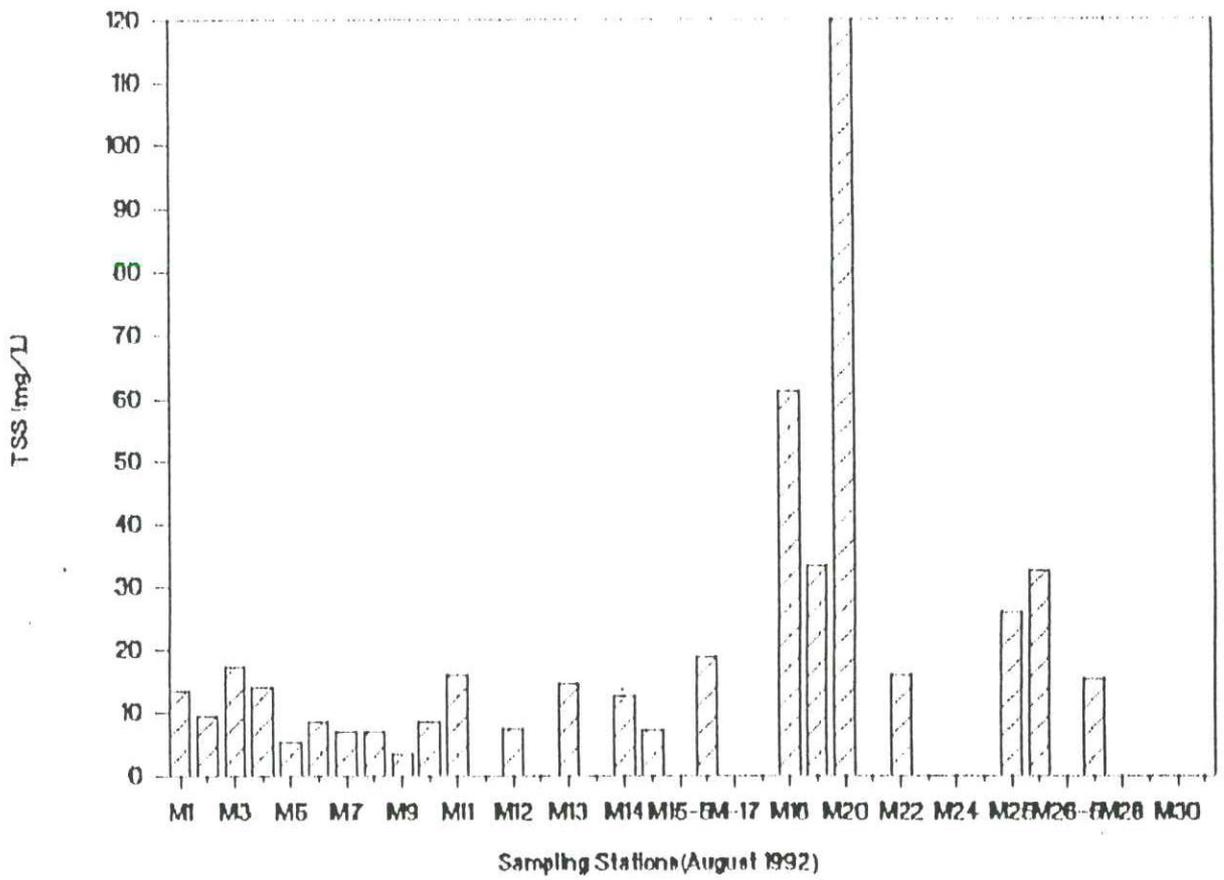


Figure 11.2. continued

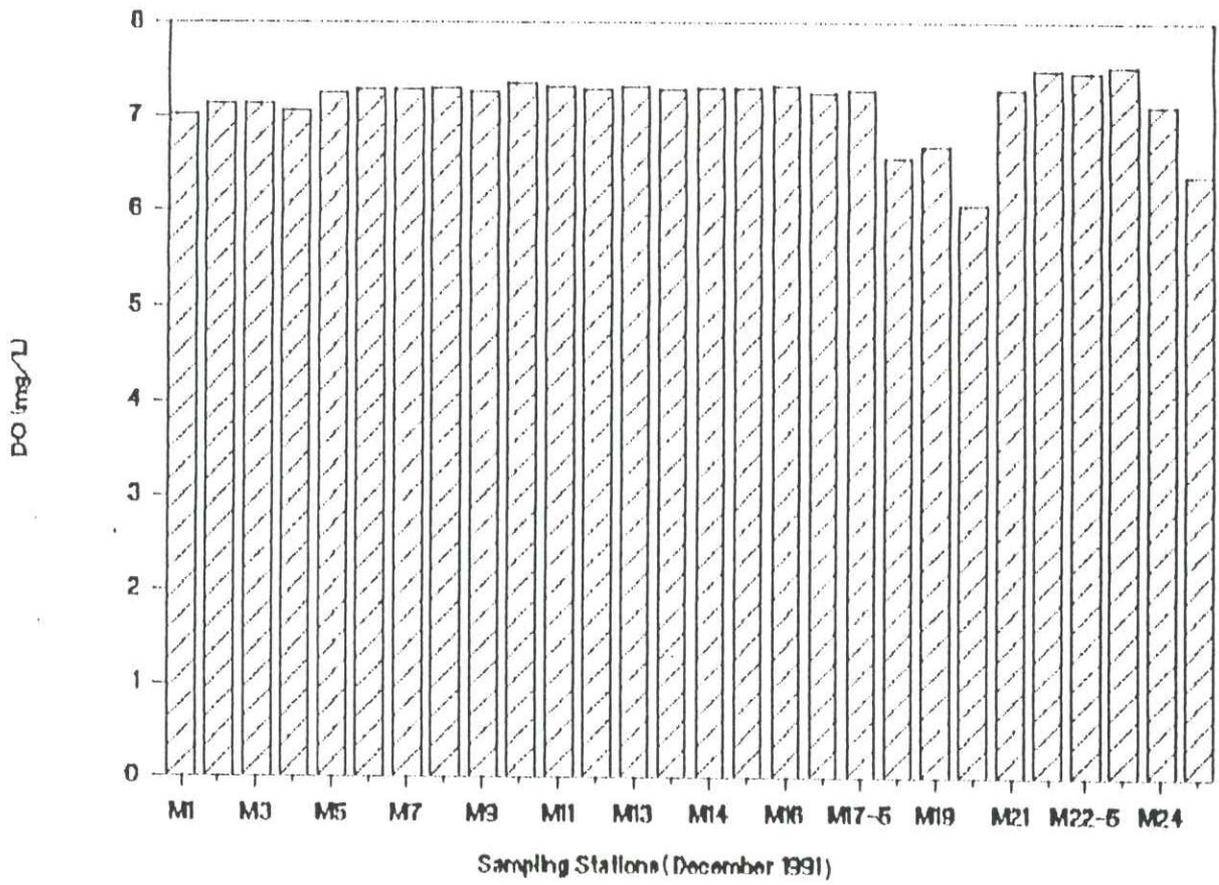


Figure II.3. The seasonal variation of Dissolved Oxygen (DO, mg/L) In Mersin Bay during December 1991-October 1992.

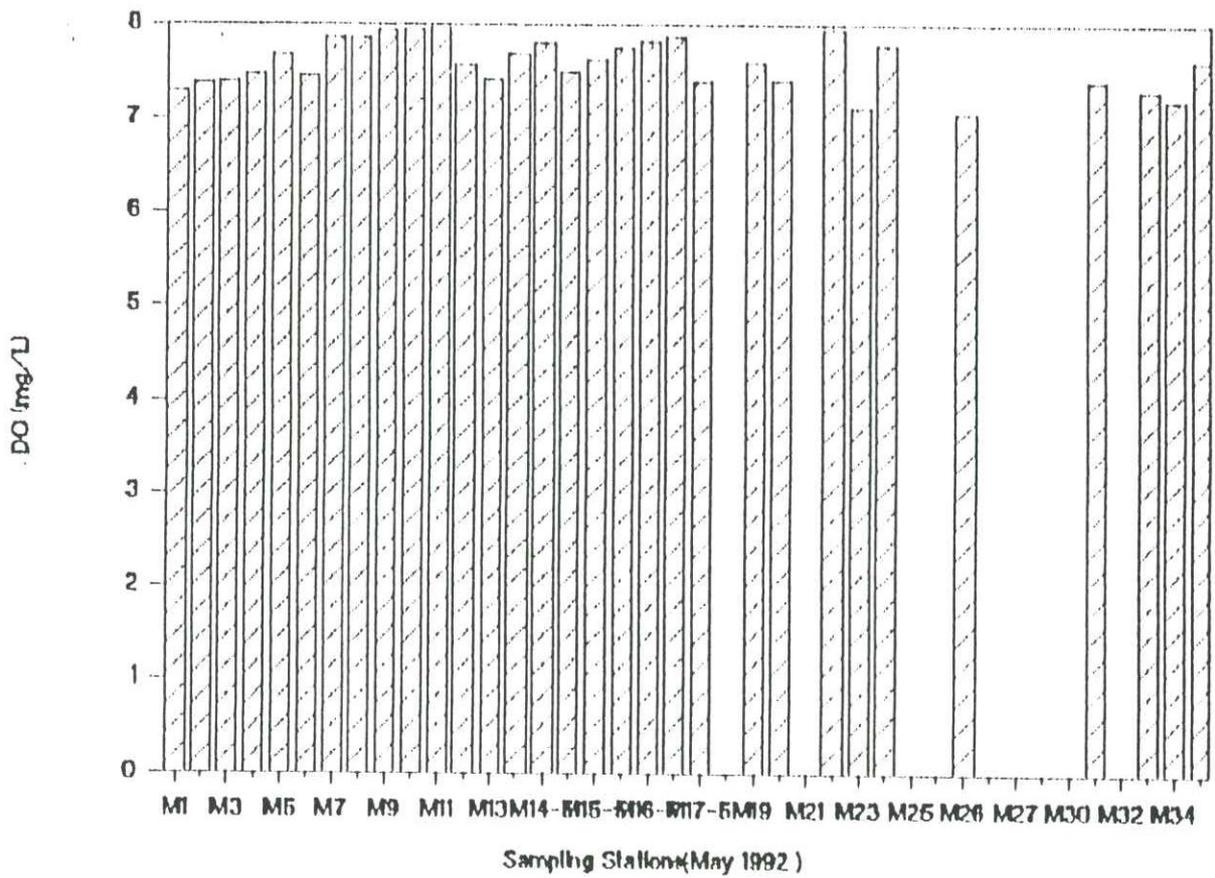
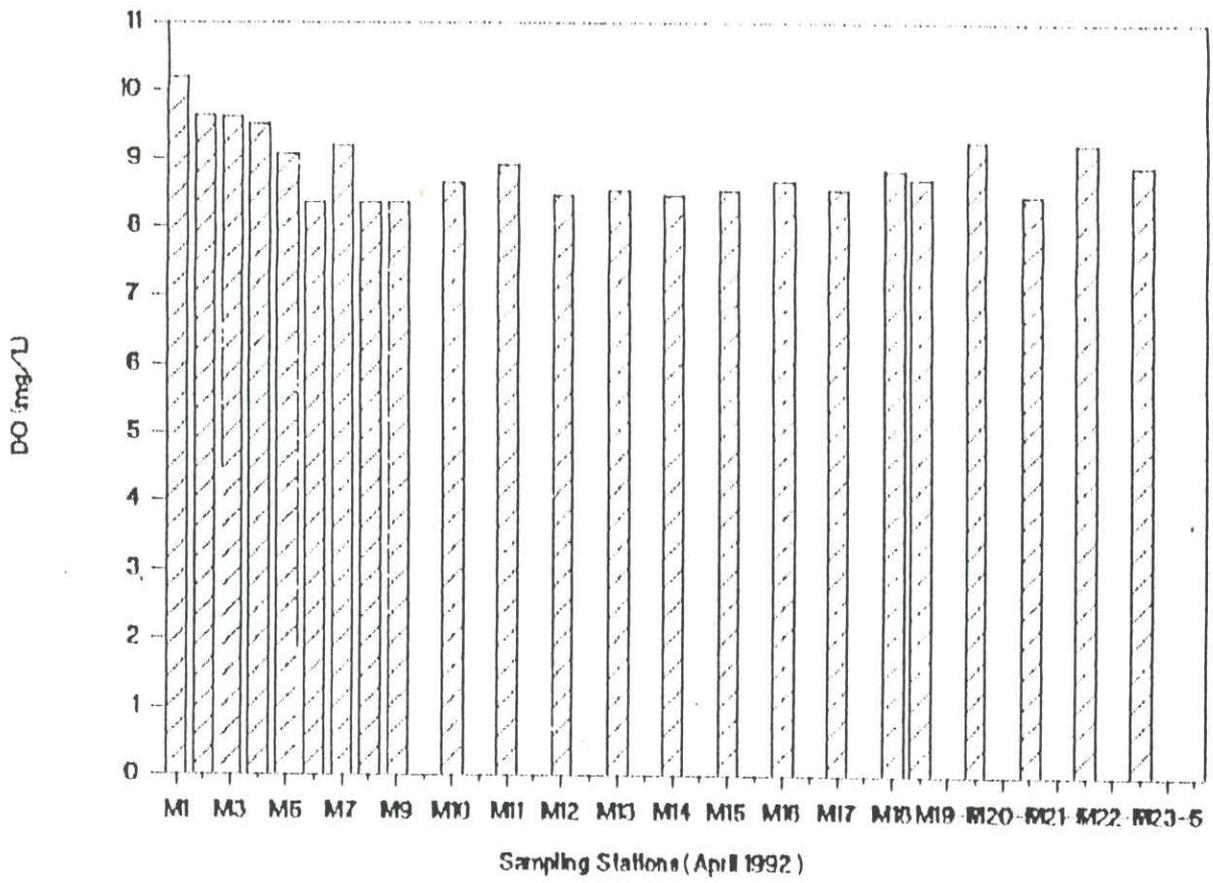


Figure II.3. continued

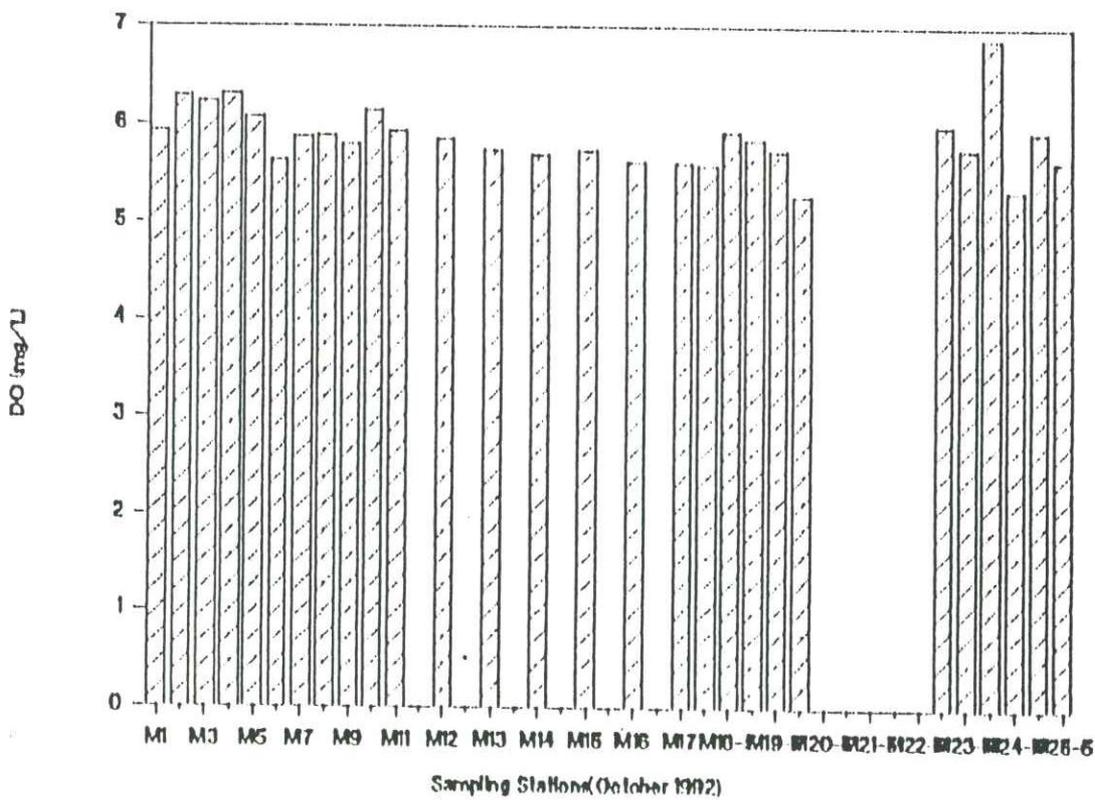
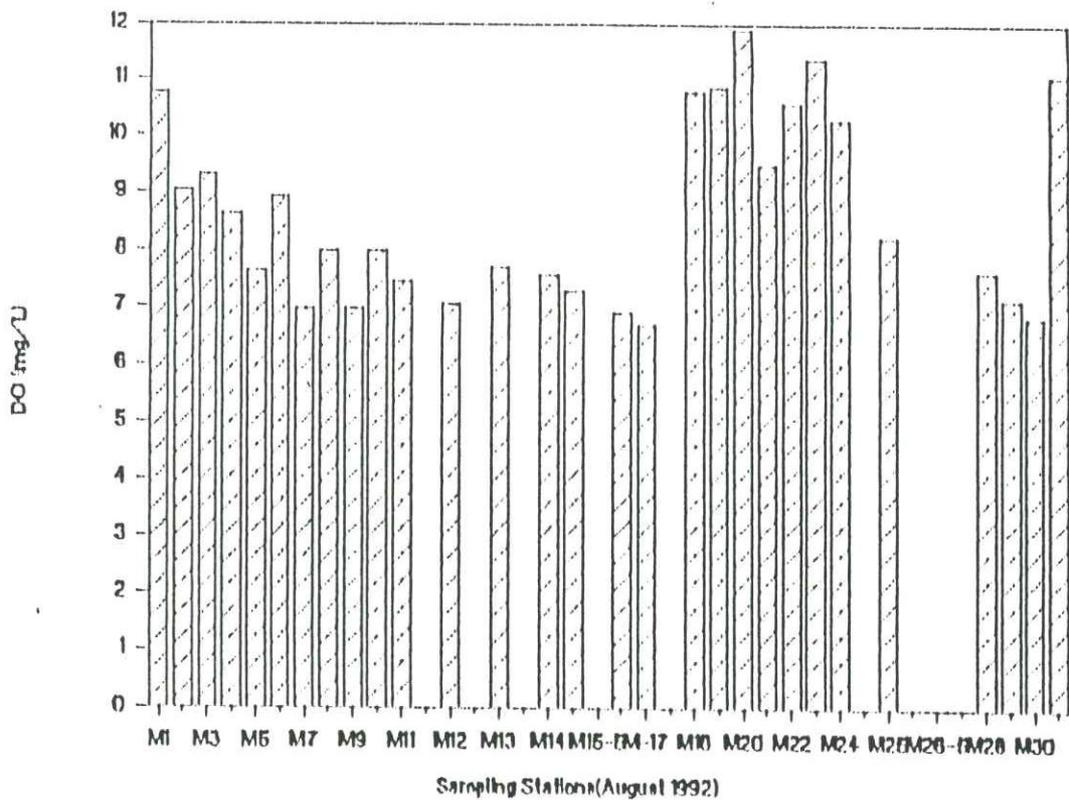


Figure II.3. continued

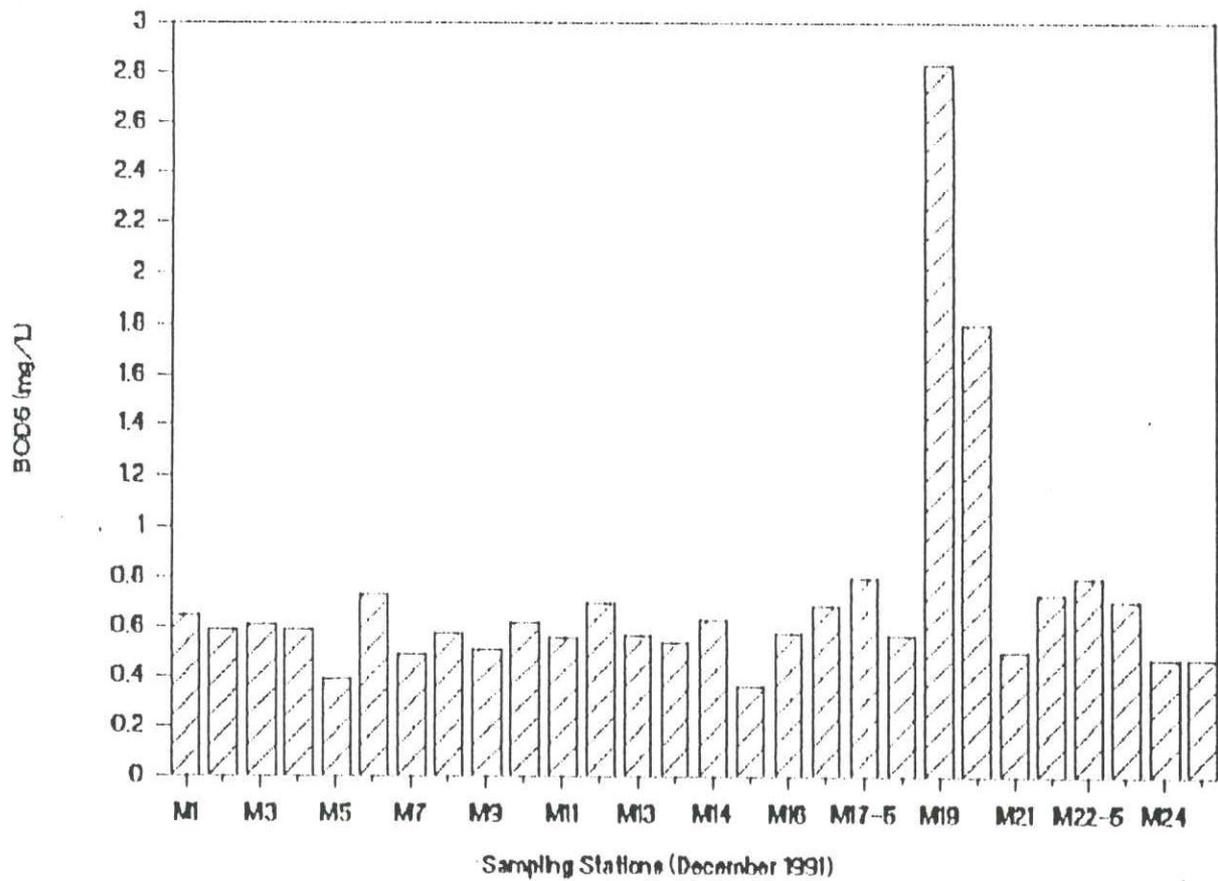


Figure II.4. The seasonal variation of Biochemical Oxygen Demand (BOD₅, mg/L) in Mersin Bay during December 1991-October 1992.

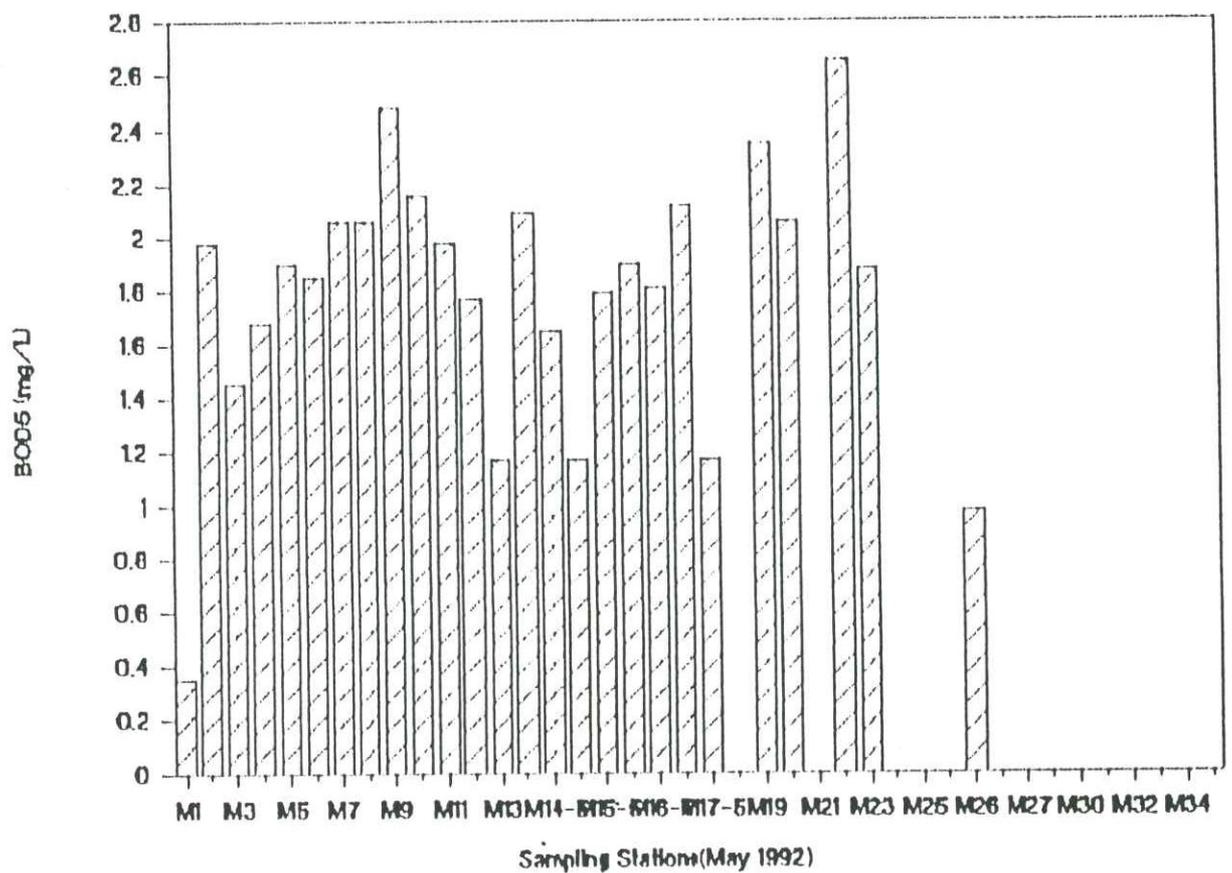
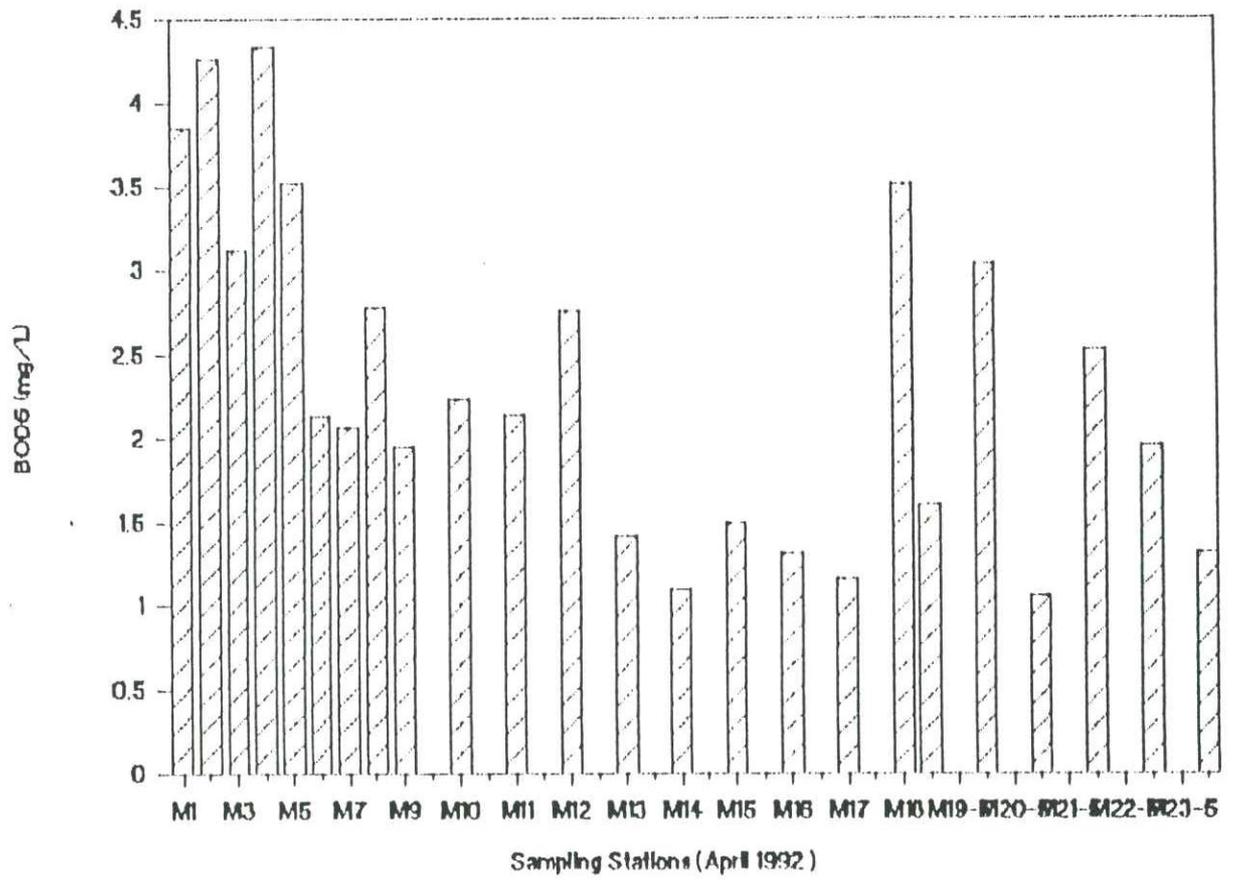


Figure II.4. continued

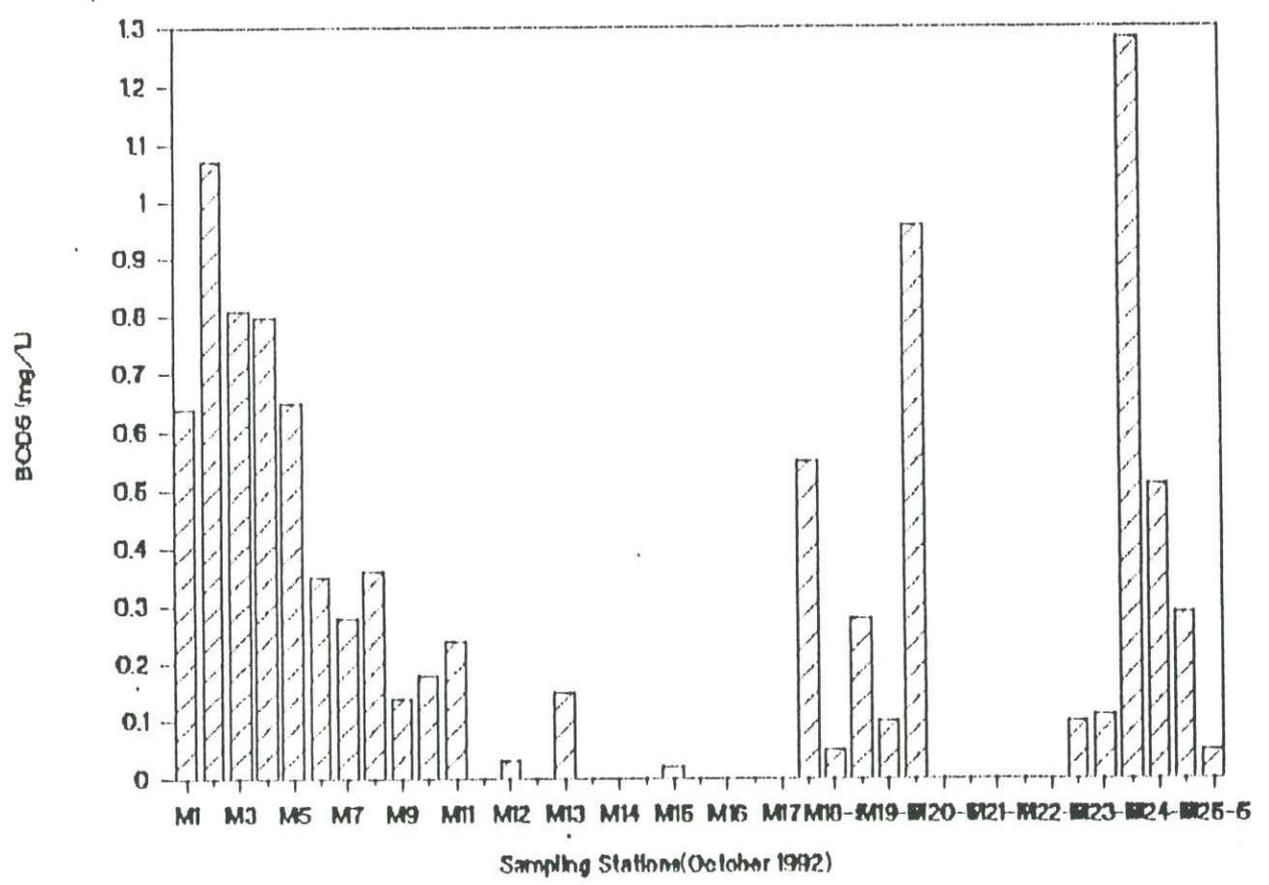
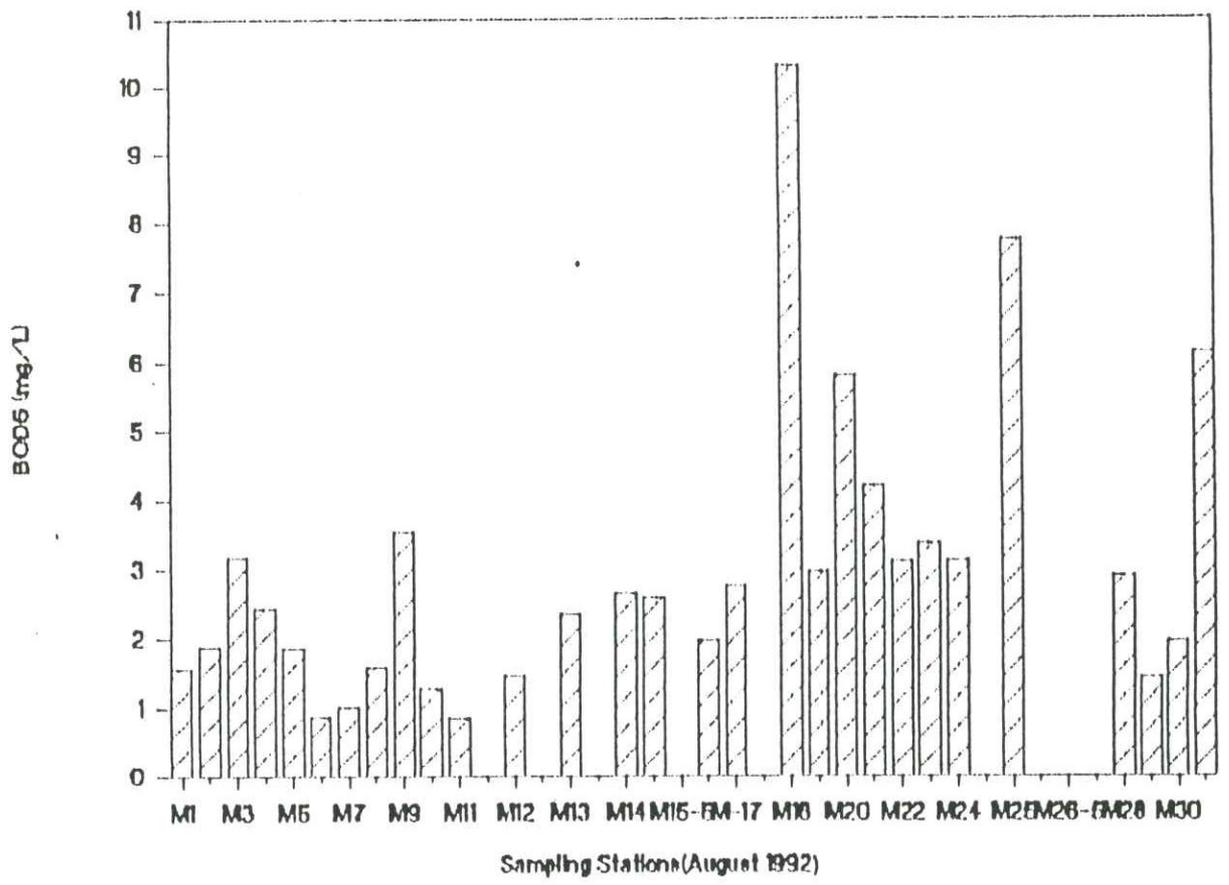


Figure II.4. continued

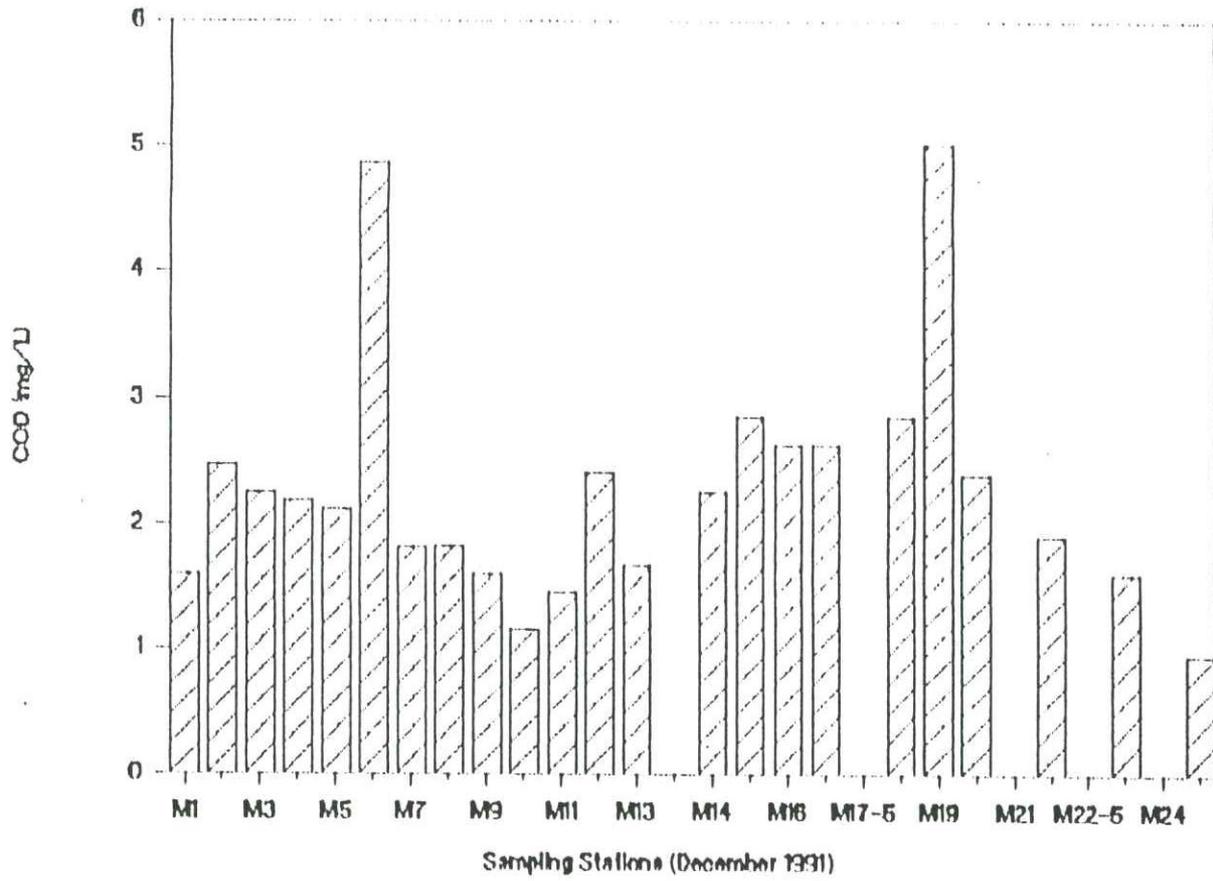


Figure 11.5. The seasonal variation of Chemical Oxygen Demand (COD, mg/L) in Mersin Bay during December 1991-October 1992.

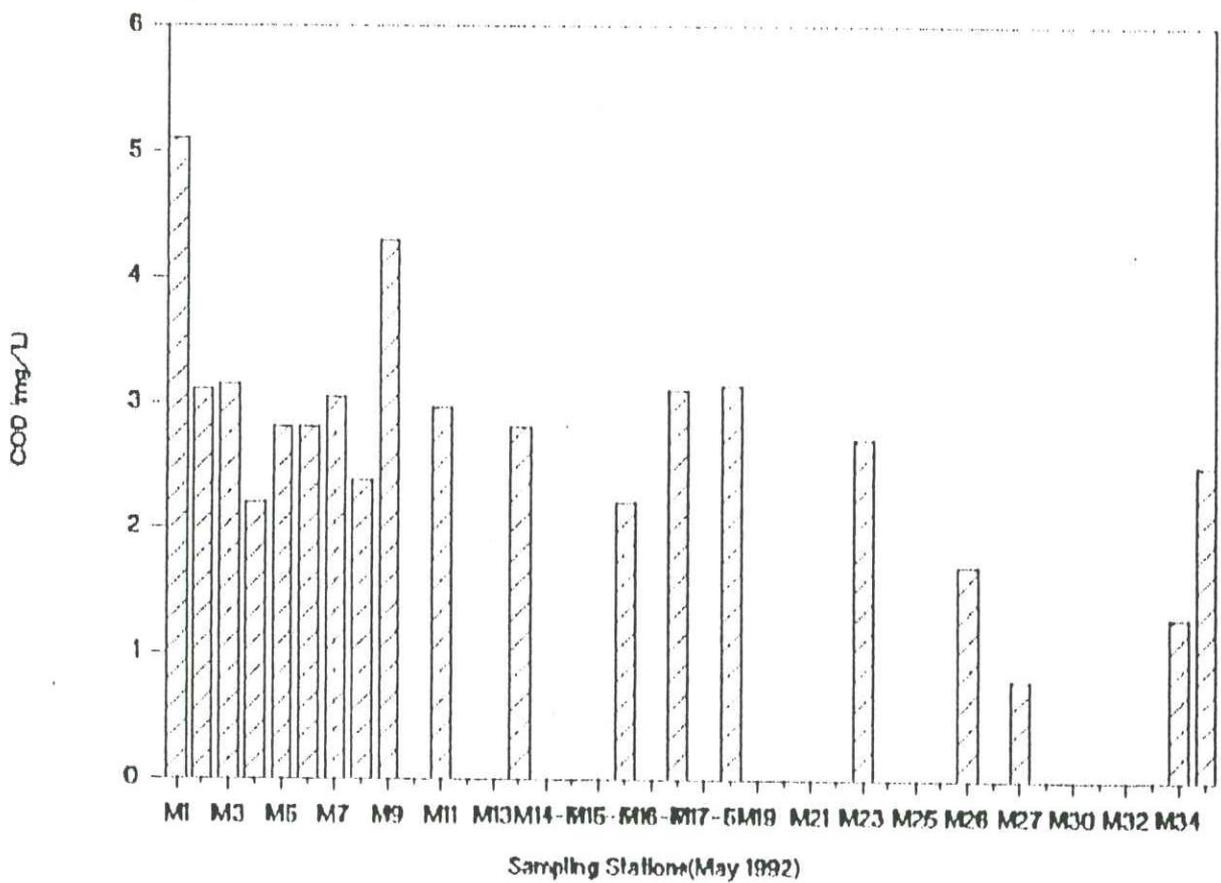
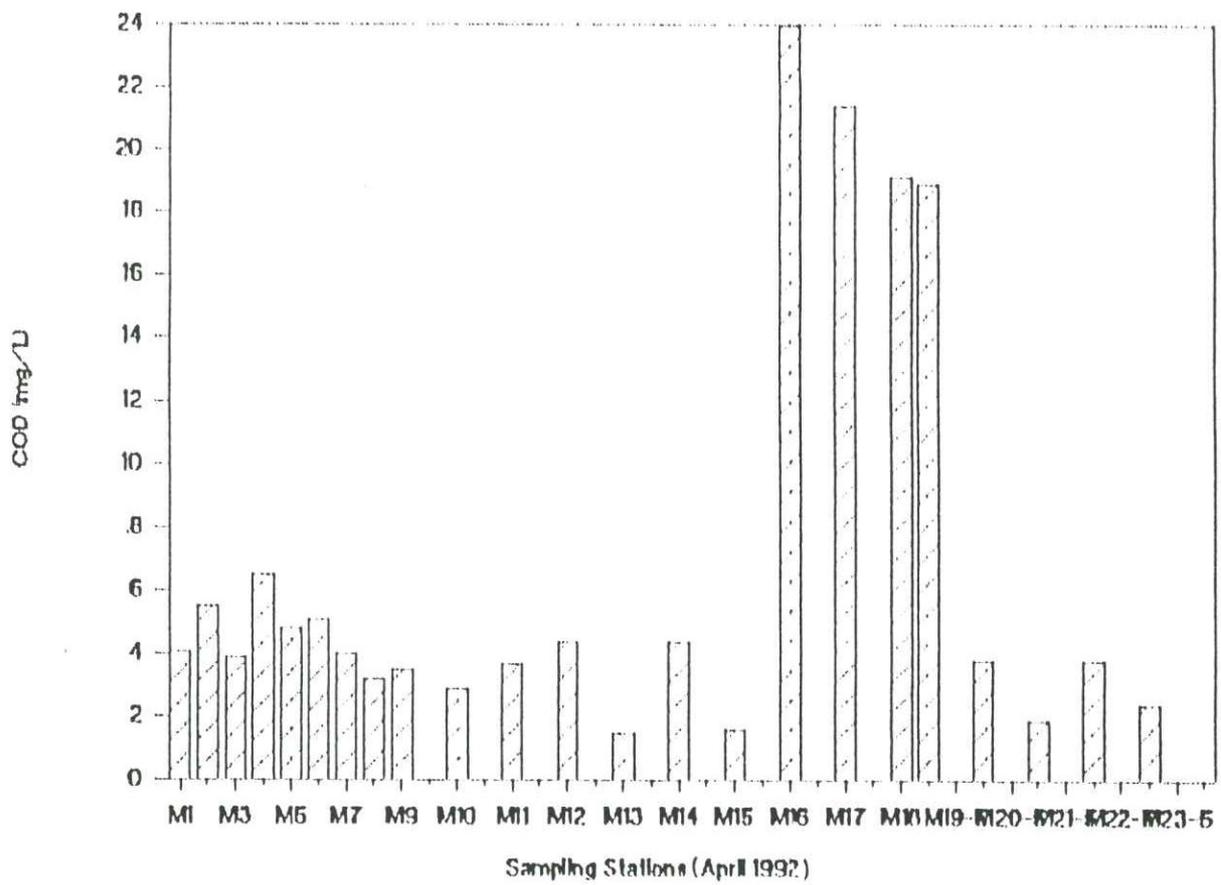


Figure II.5. continued

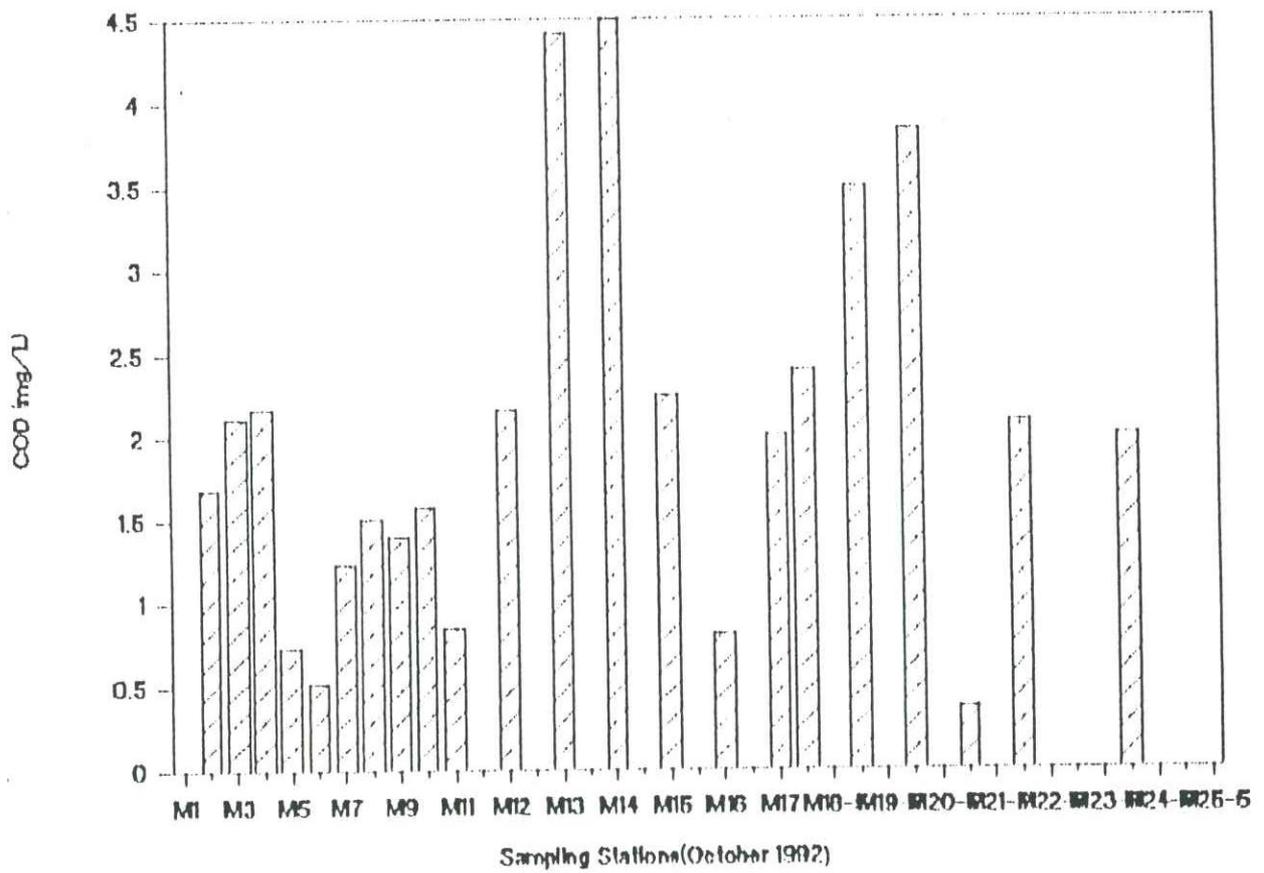
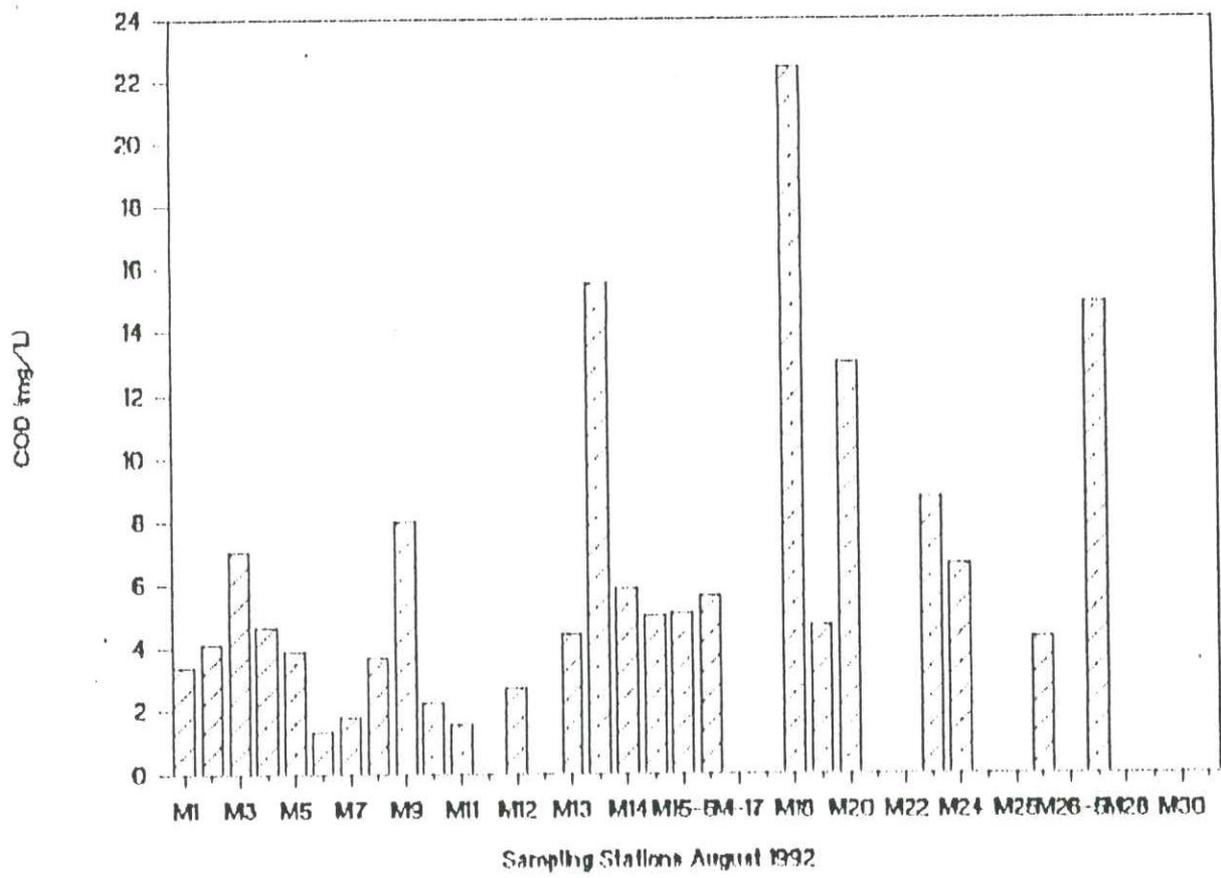


Figure II.5. continued

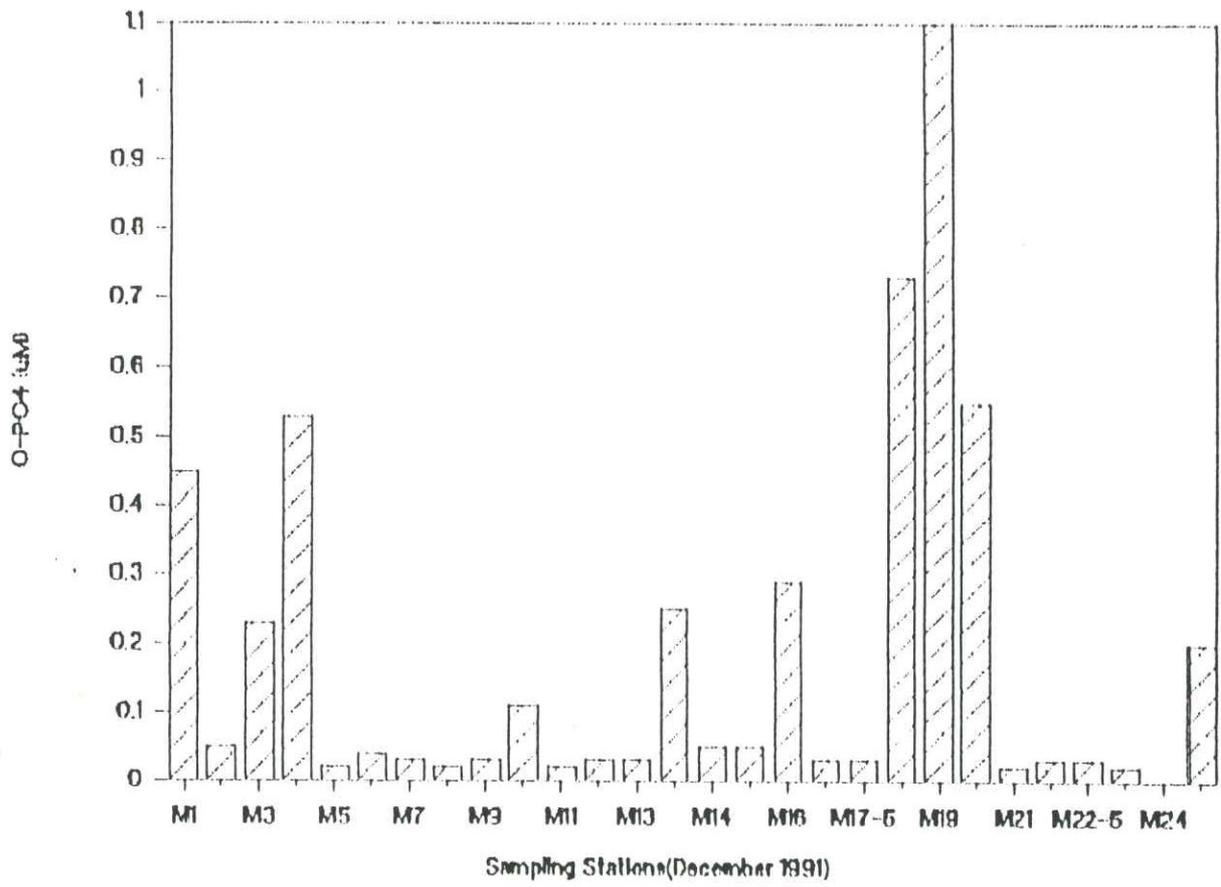


Figure 11.6. The seasonal variation of Inorganic Phosphate (o-PO₄, μM) in Mersin Bay during December 1991-October 1992.

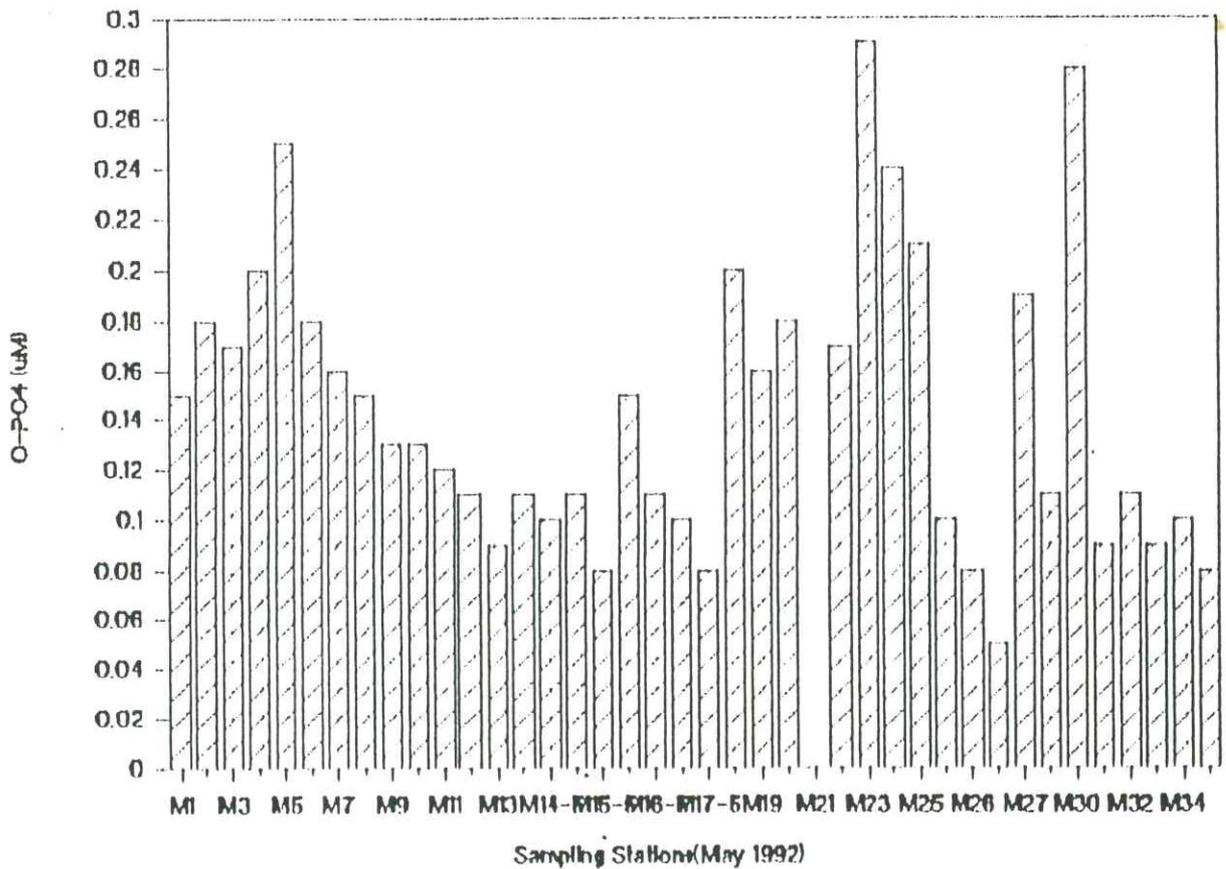
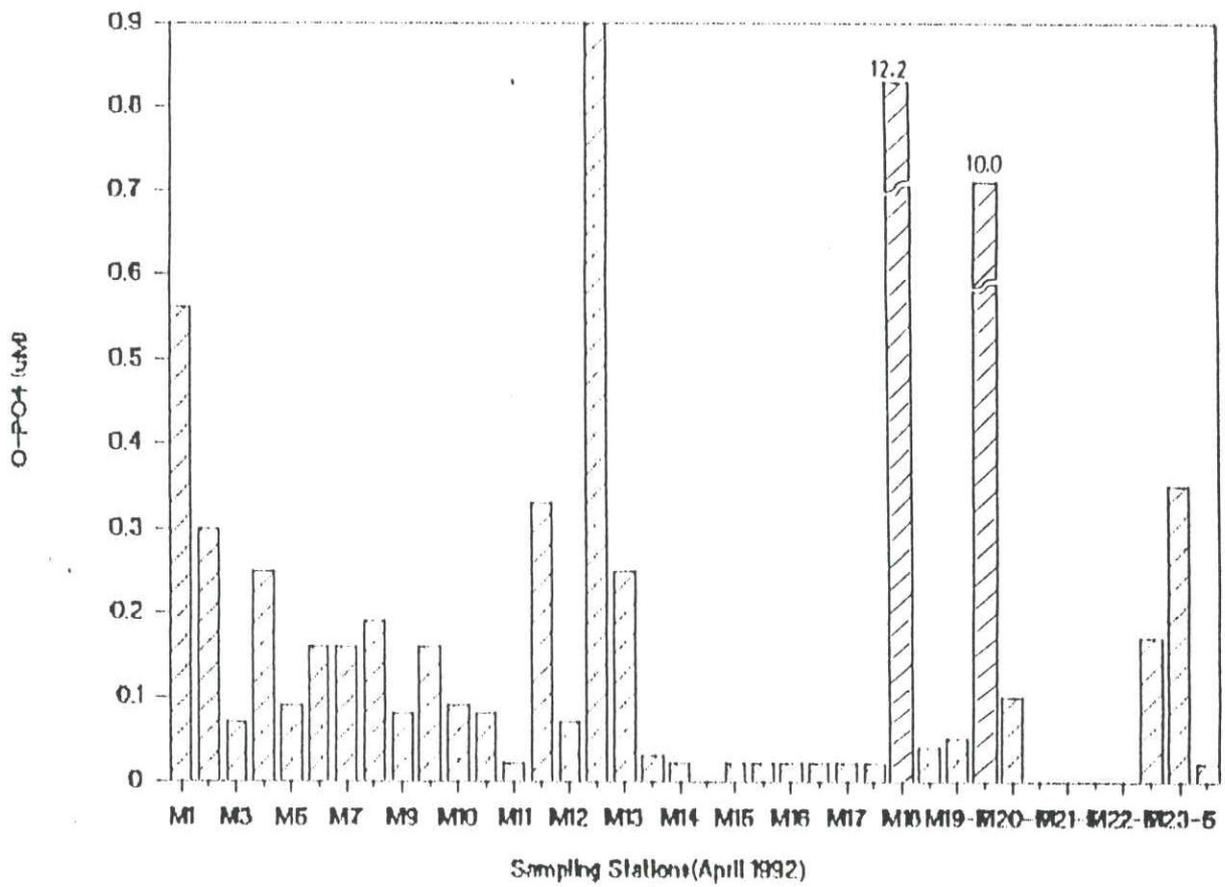


Figure II.6. continued

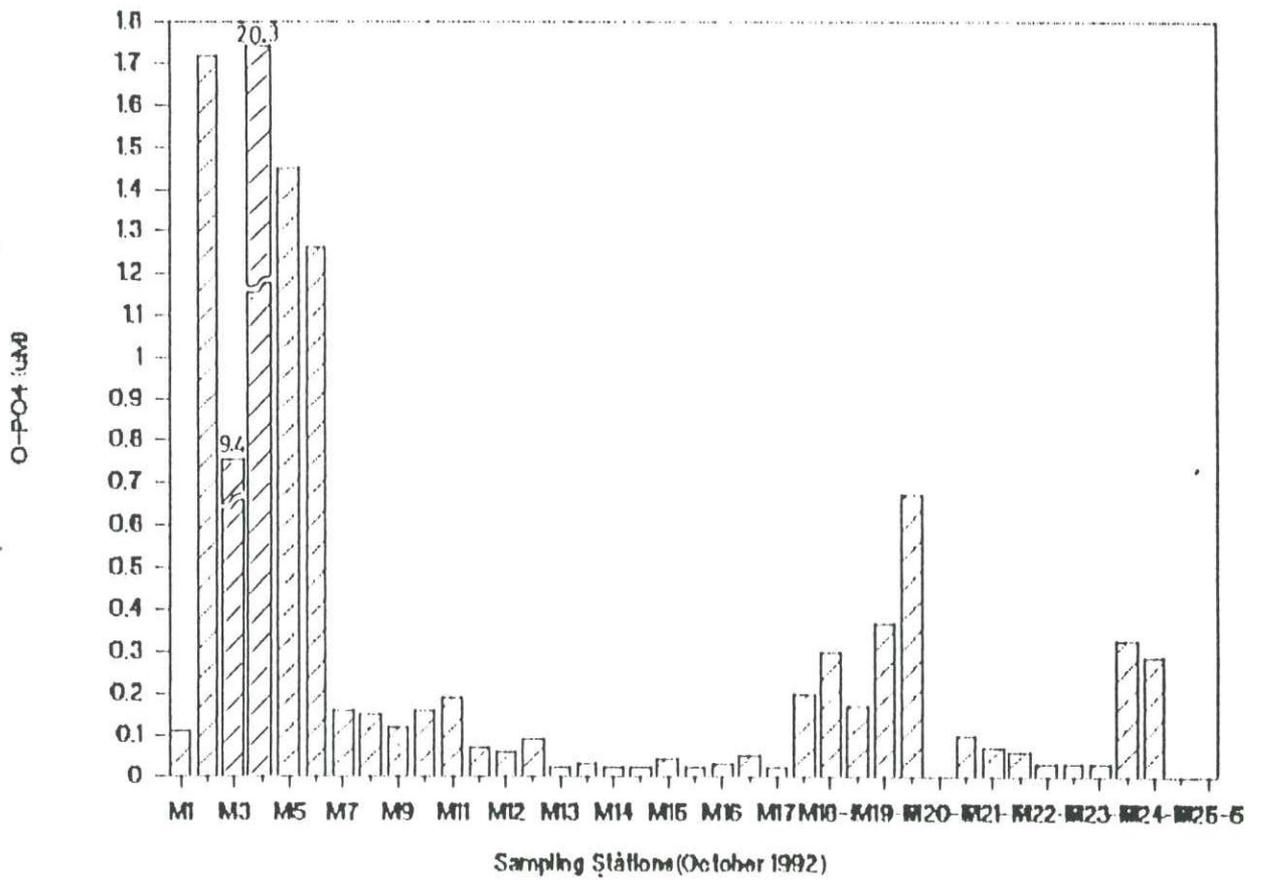
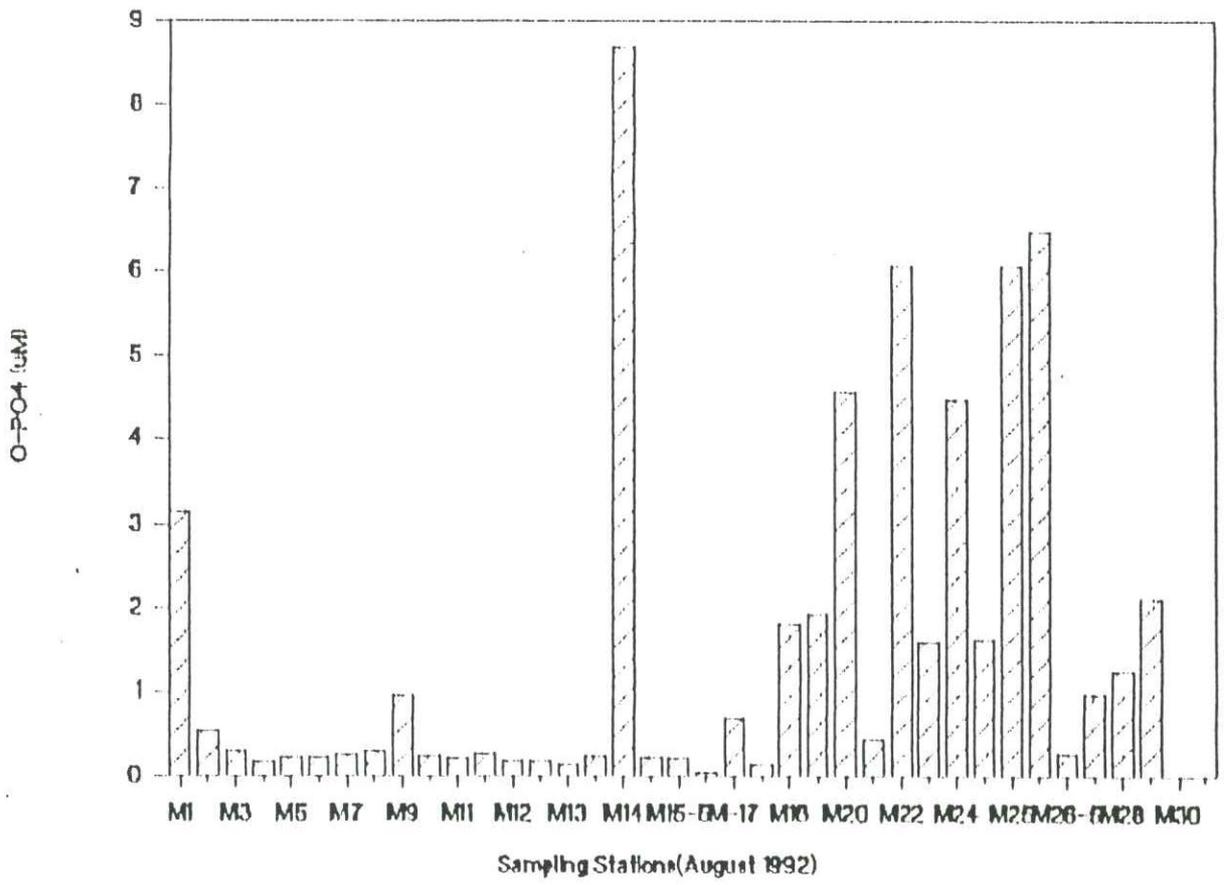


Figure II.6. continued

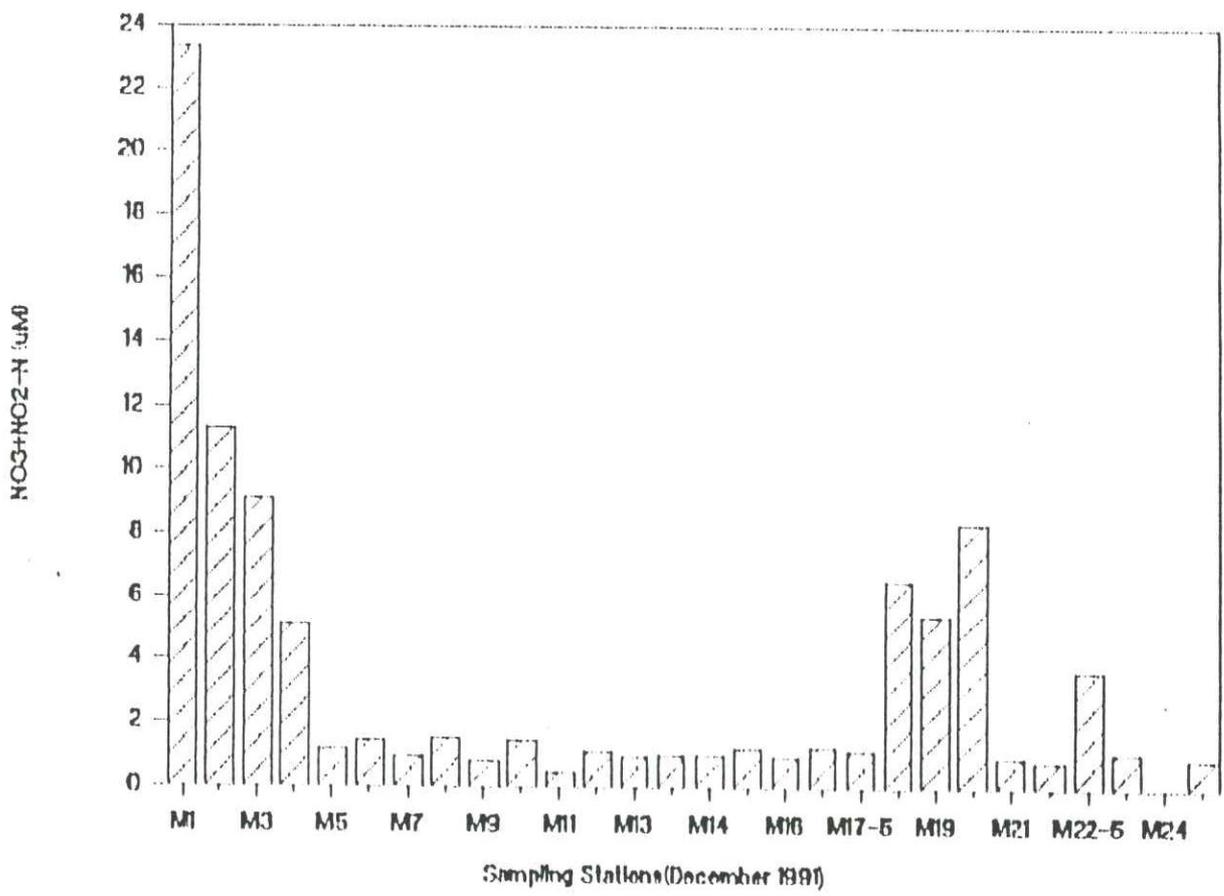


Figure II.7. The seasonal variation of Total Oxidized Nitrogen ($\text{NO}_3 + \text{NO}_2$, μM) in Mersin Bay during December 1991-October 1992.

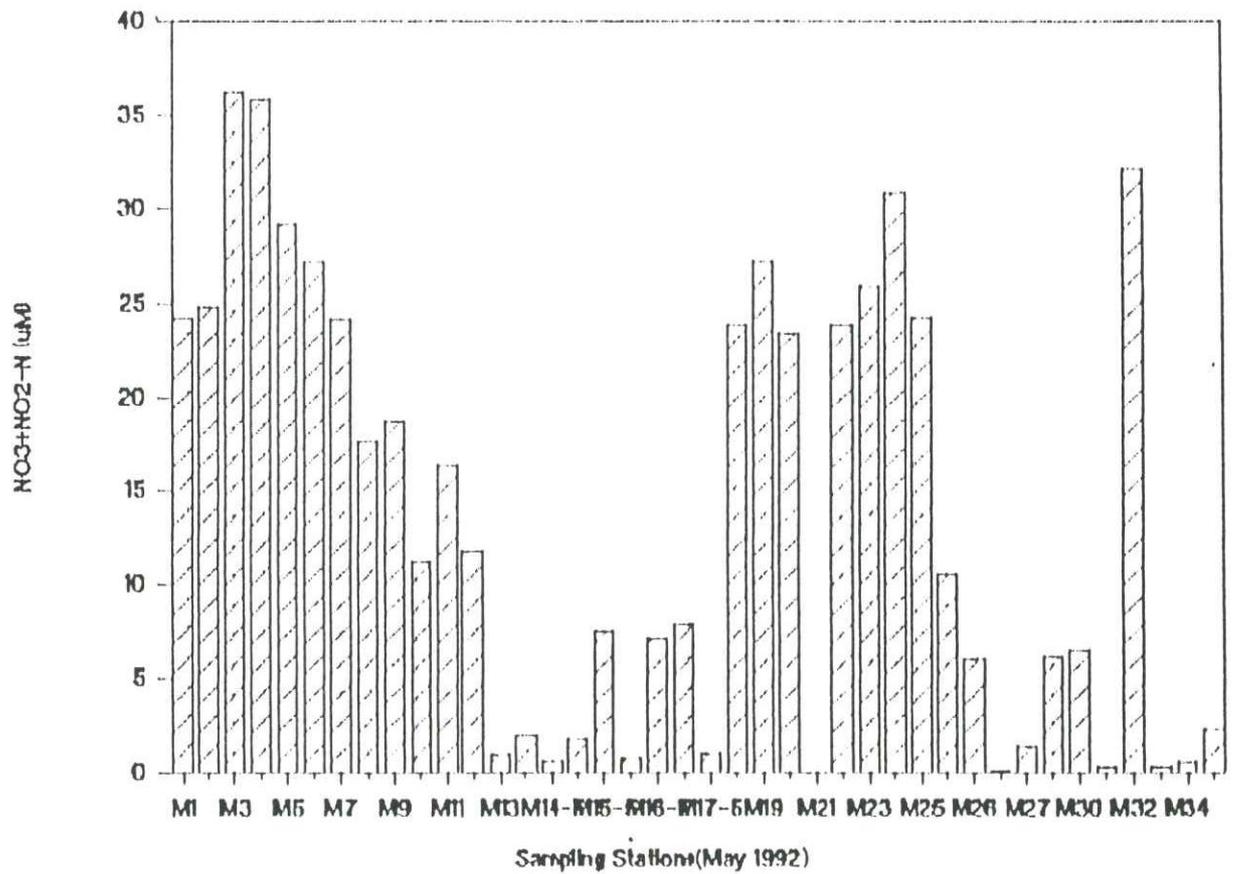
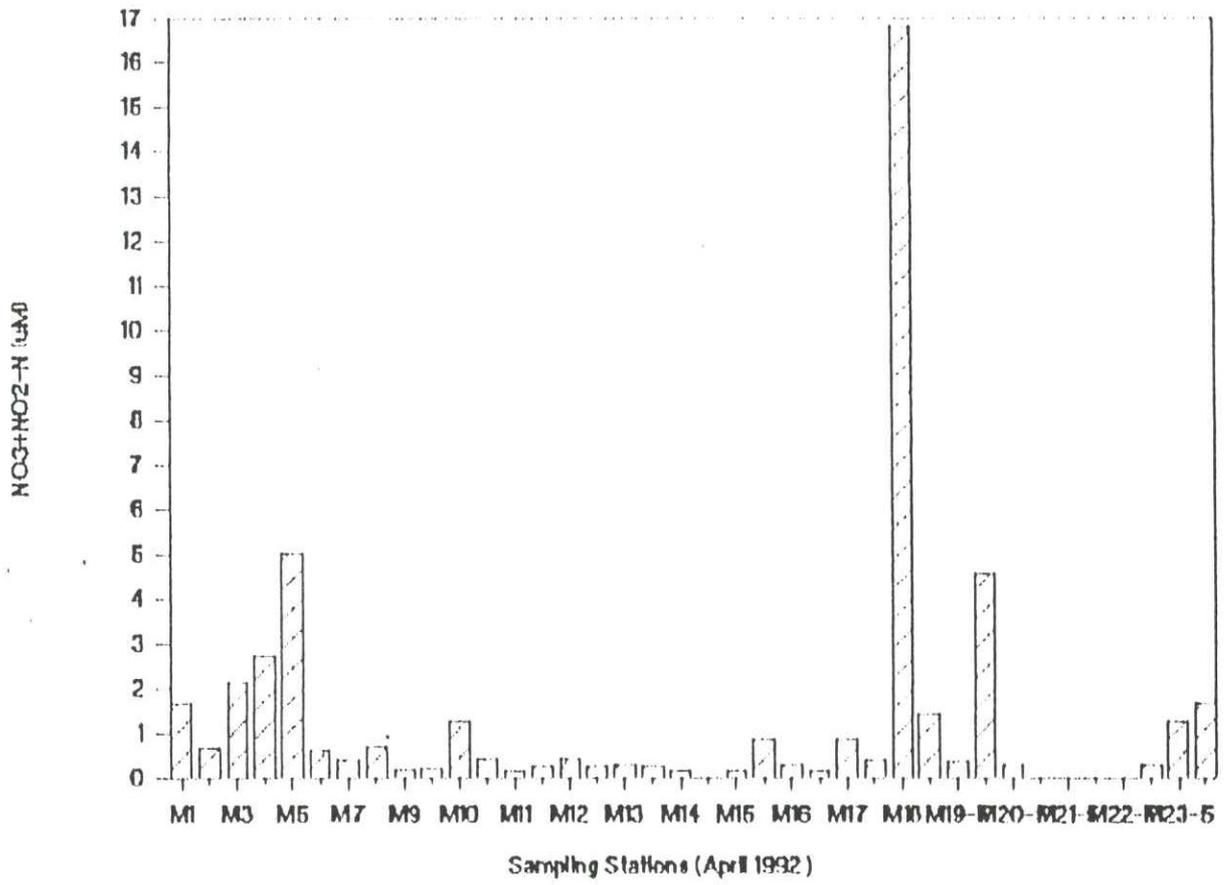


Figure II.7. continued

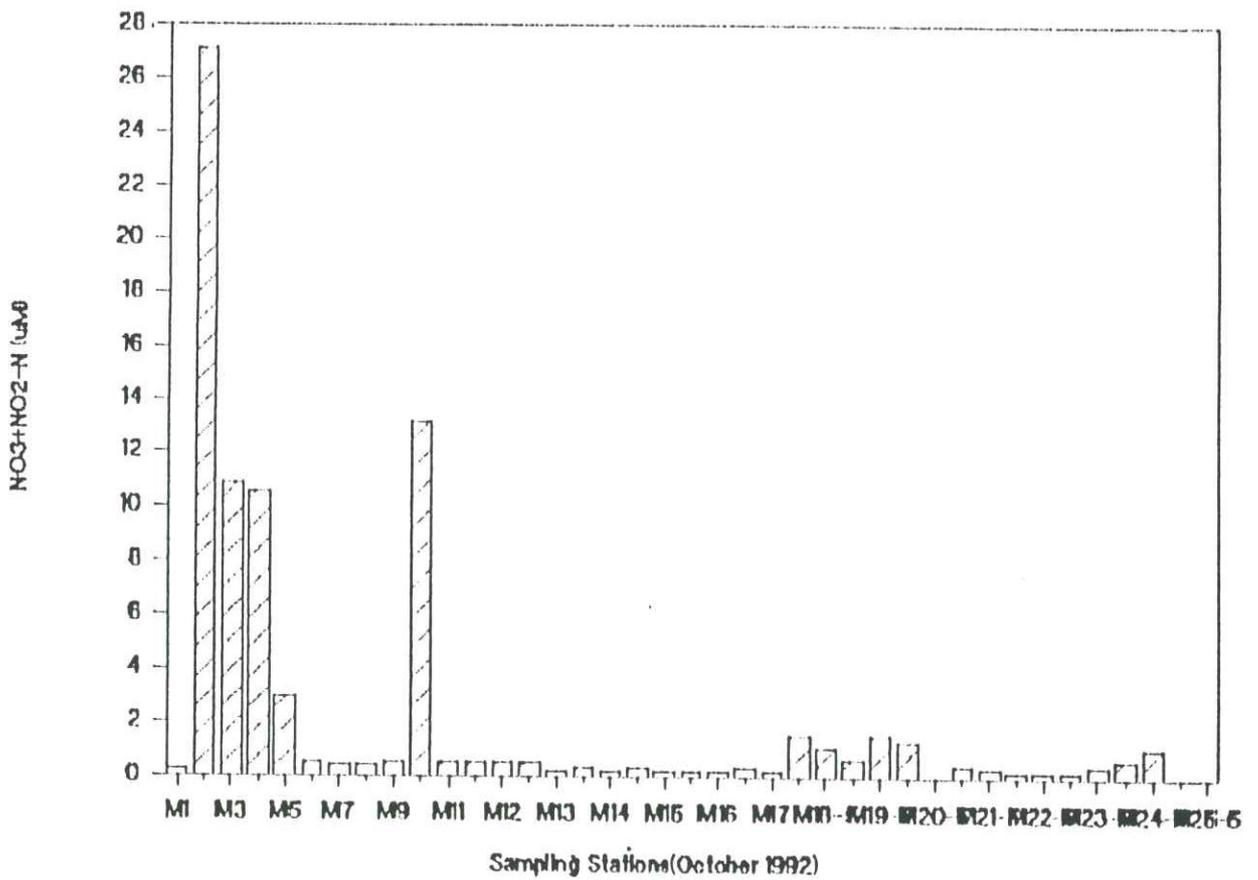
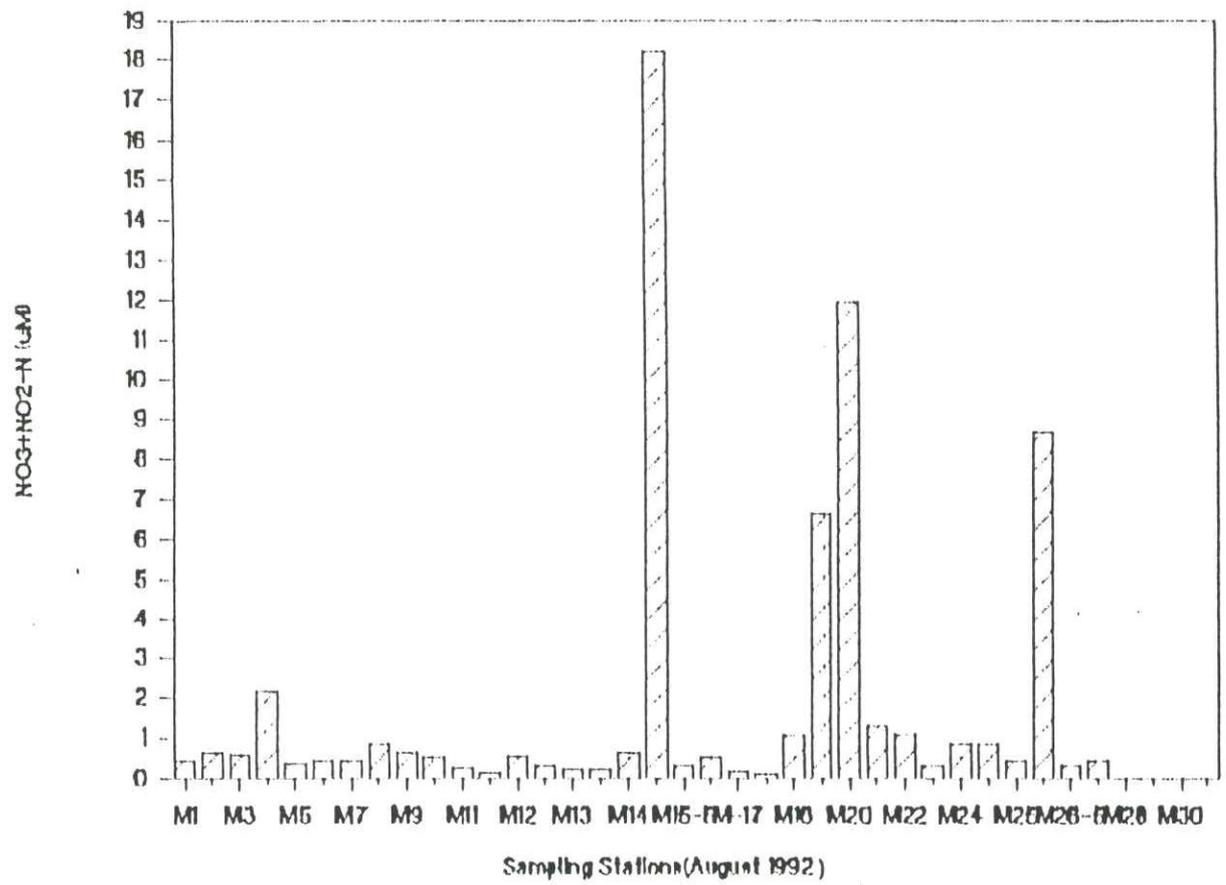


Figure II.7. continued

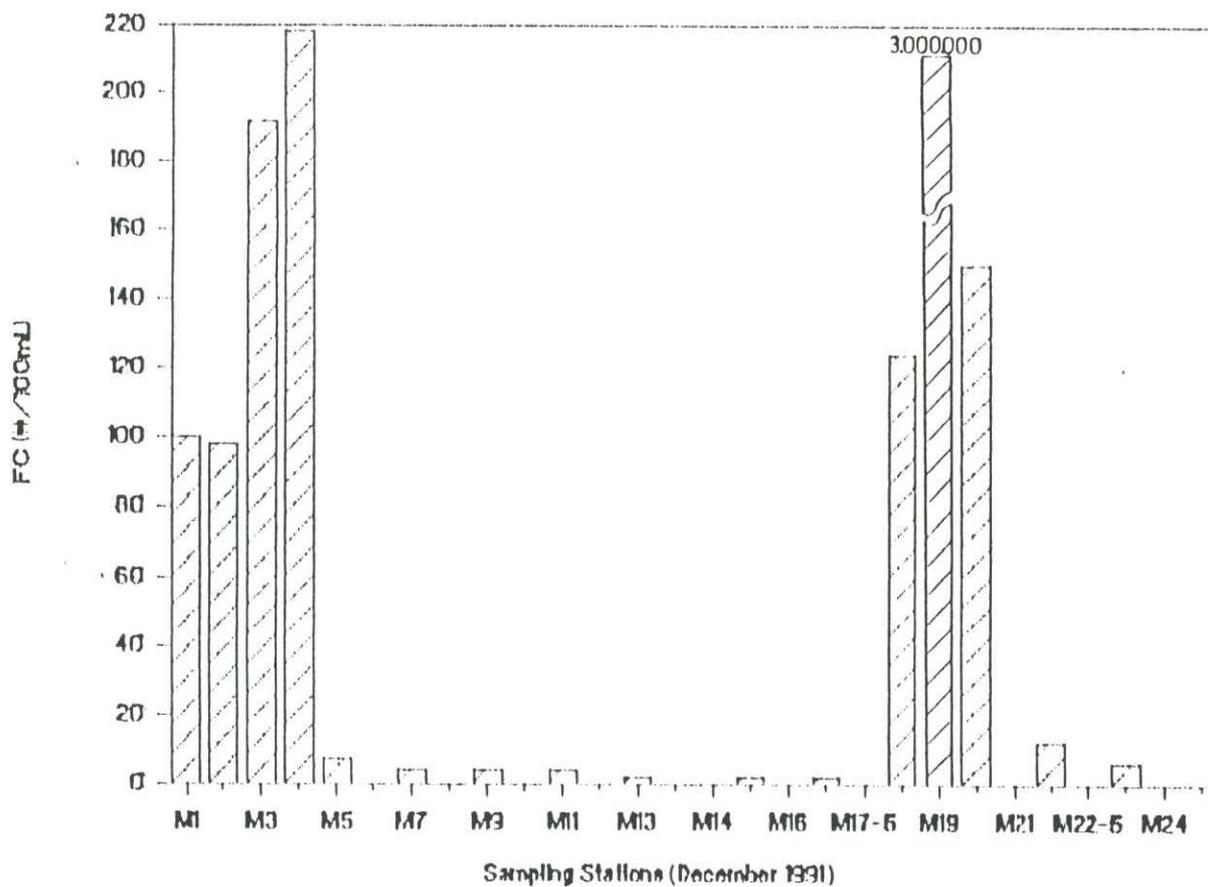


Figure II.8. The seasonal variation of Faecal Coliform (FC, #/100mL) in Mersin Bay during December 1991-October 1992.

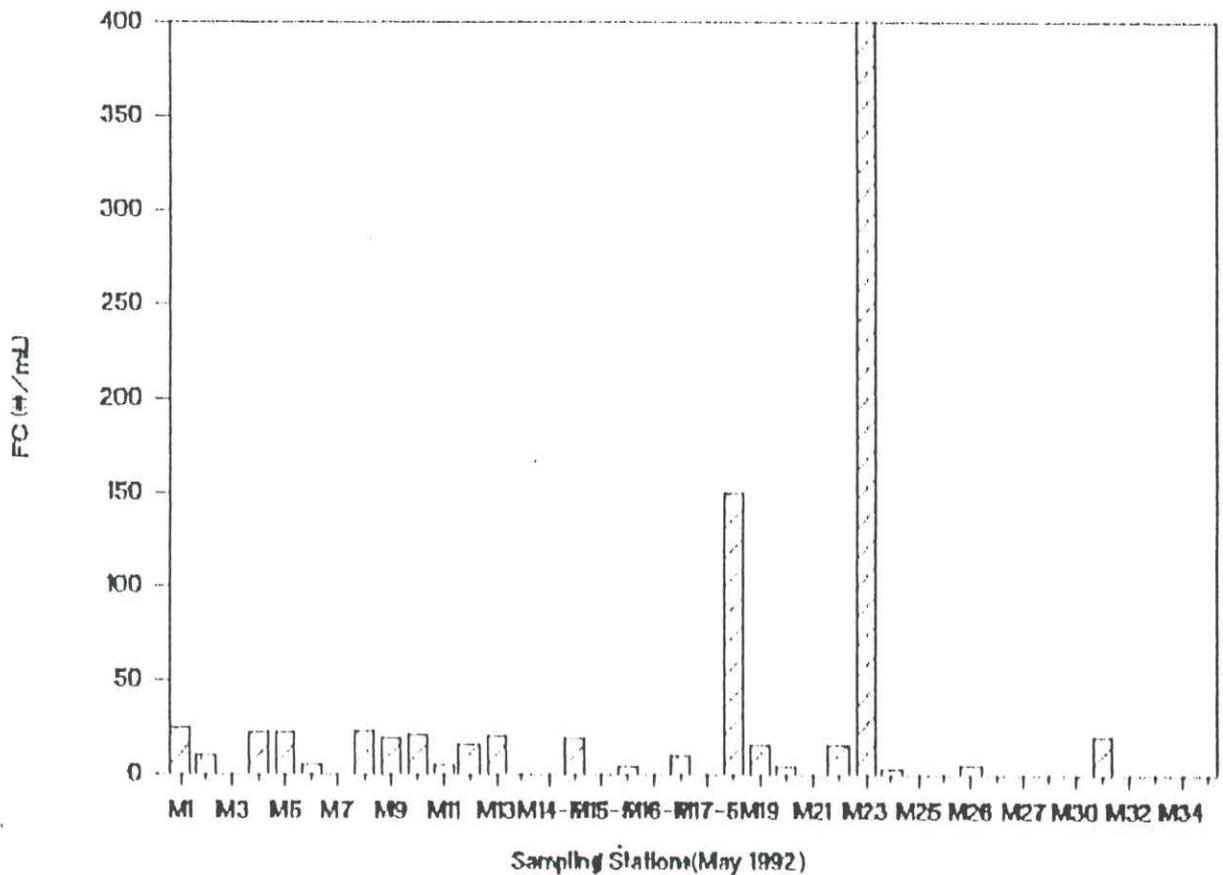
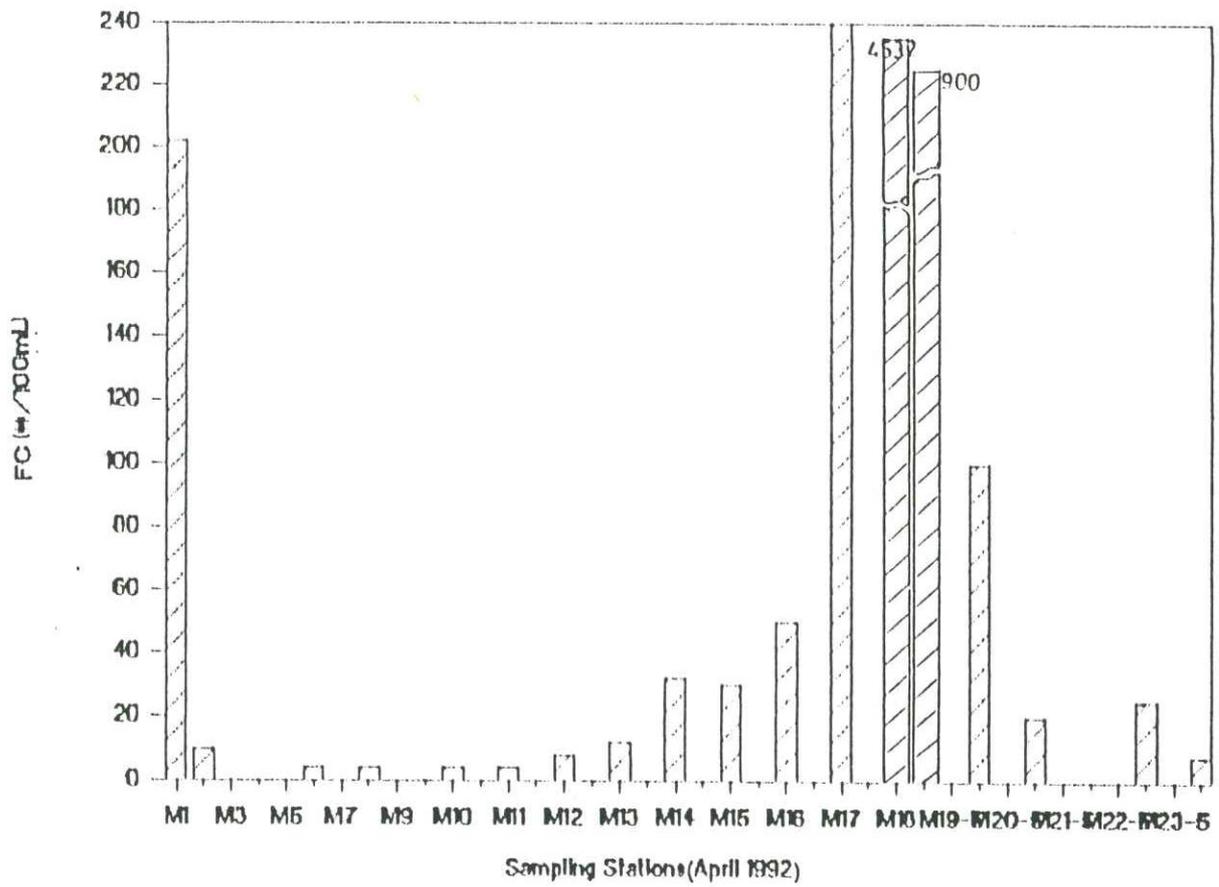


Figure II.8. continued

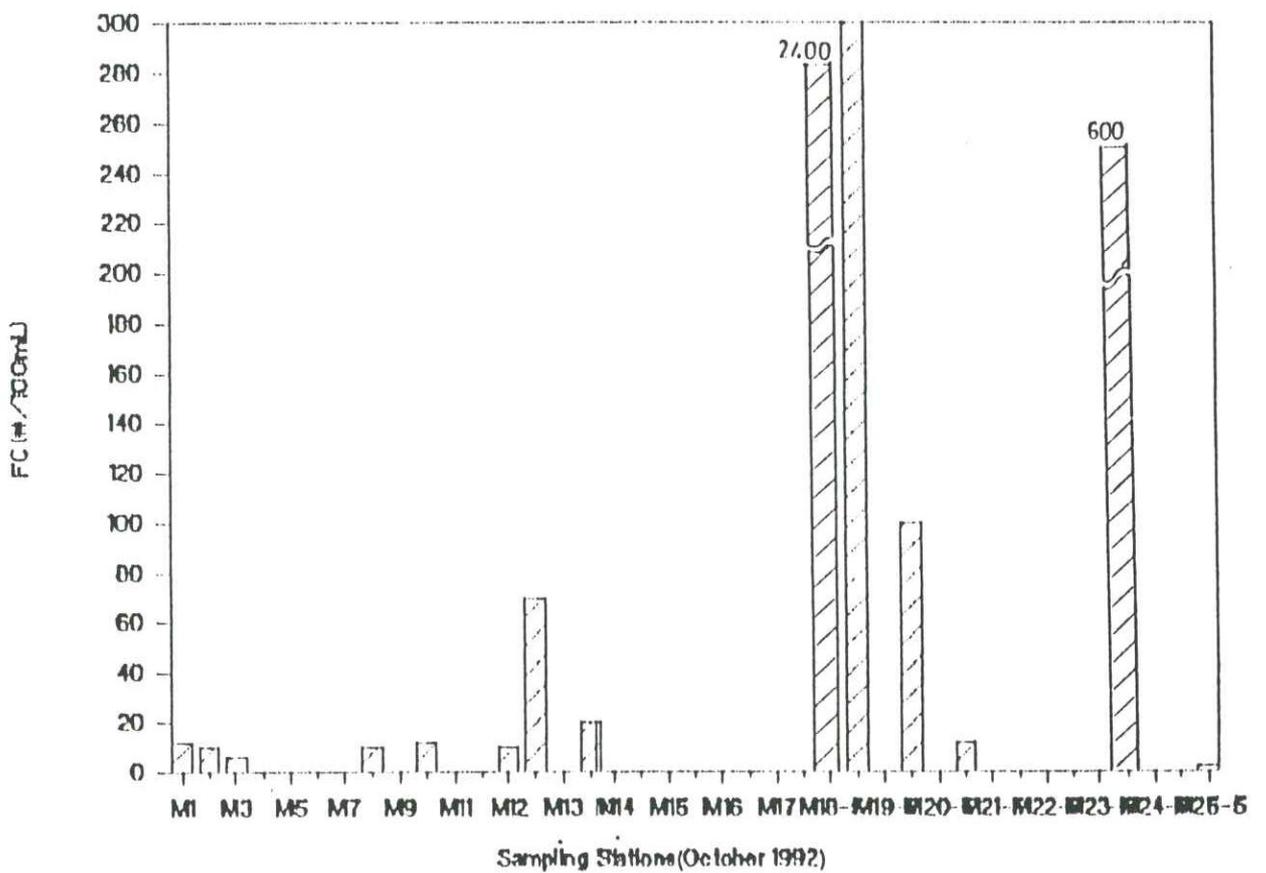
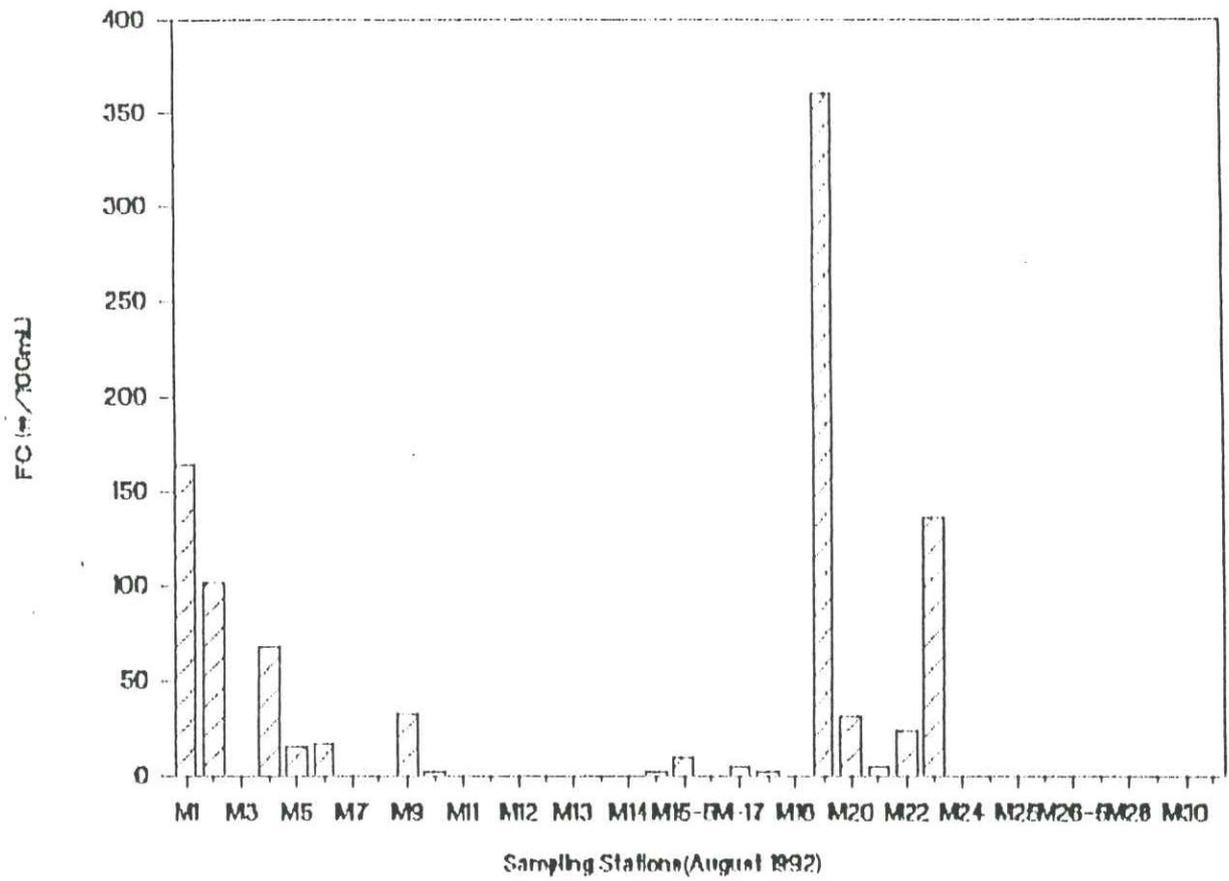


Figure II.8. continued

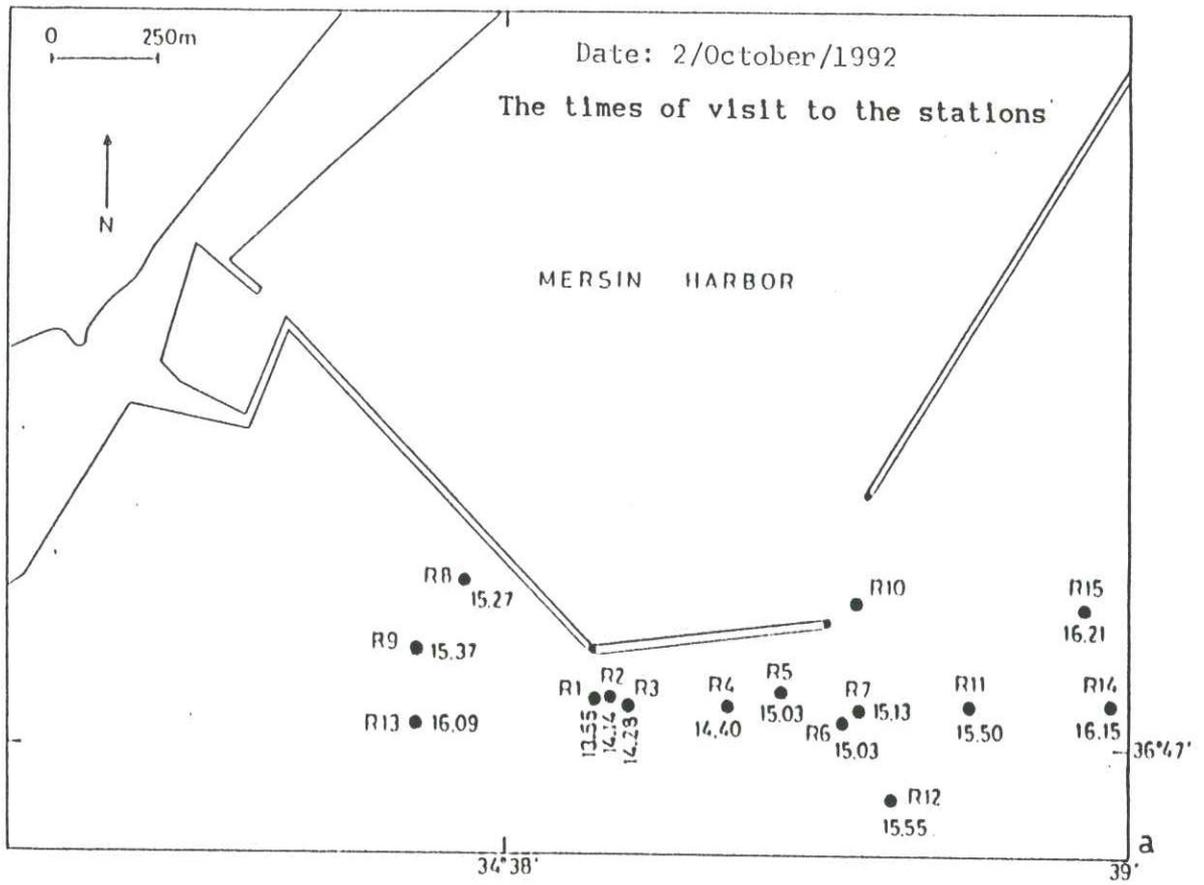


Figure II.9.a. The times of visit to the stations during Rhodamine-B dye tracing in Mersin Bay on 2nd of October 1992

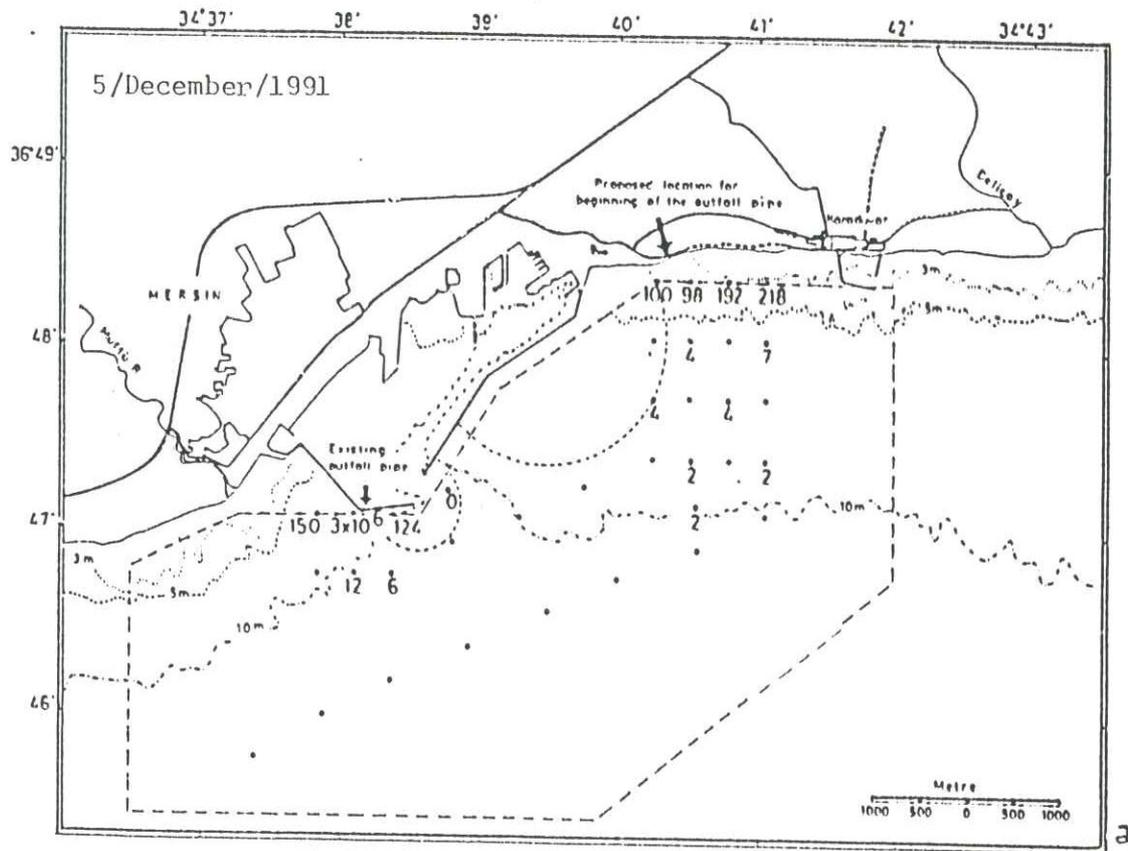


Figure II.10. The seasonal distribution of Faecal Coliforms in Mersin Coastal waters during 1991-1992.

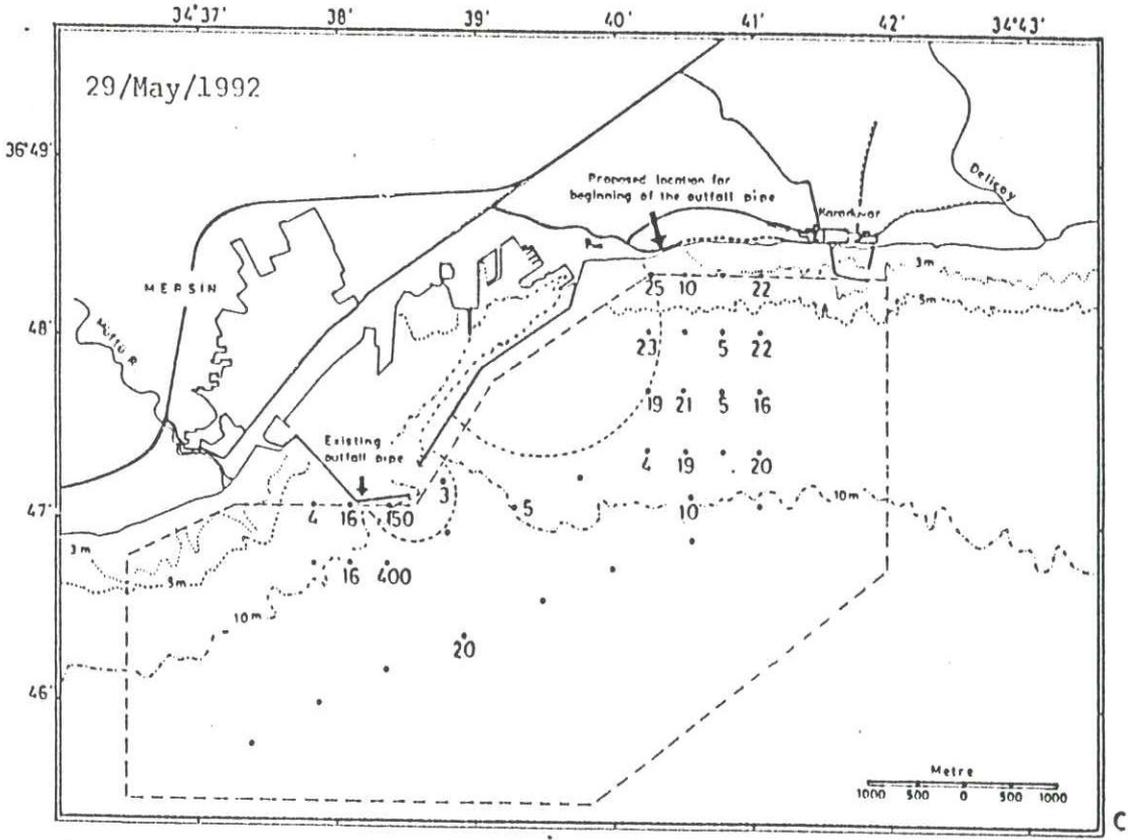
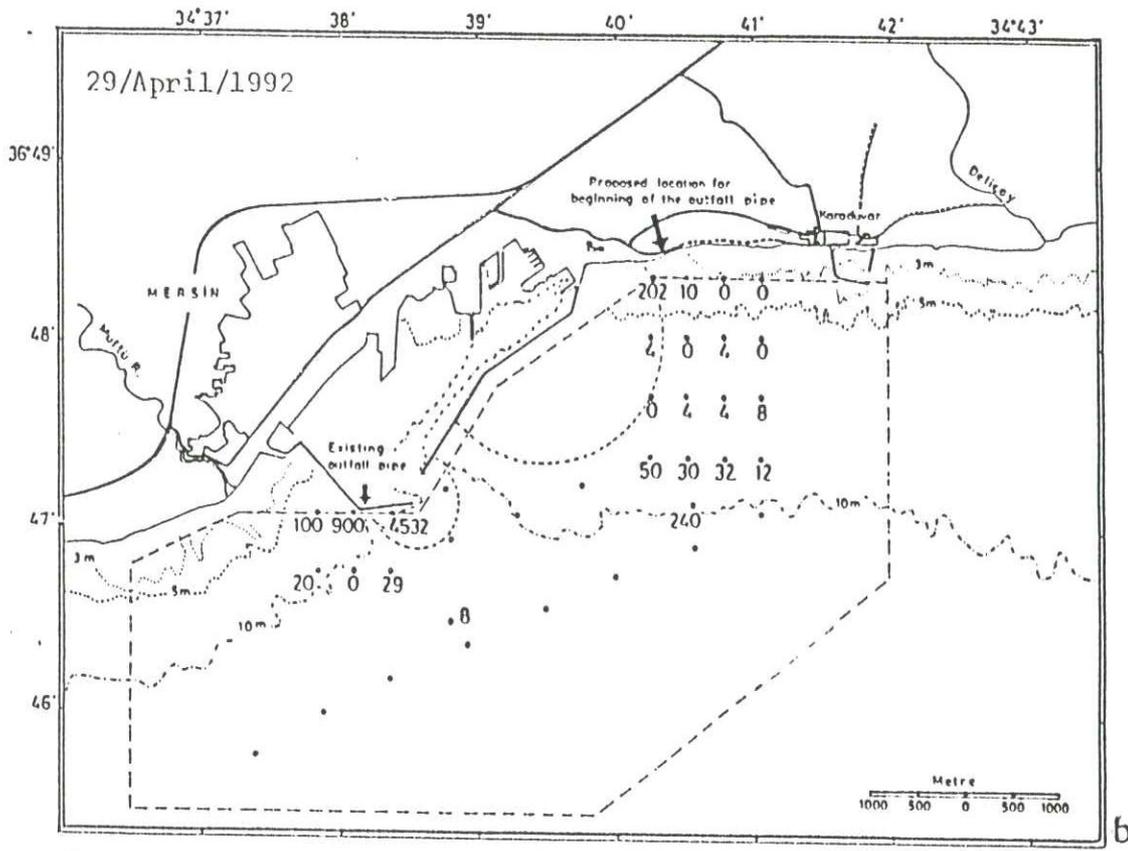


Figure II.10. continued

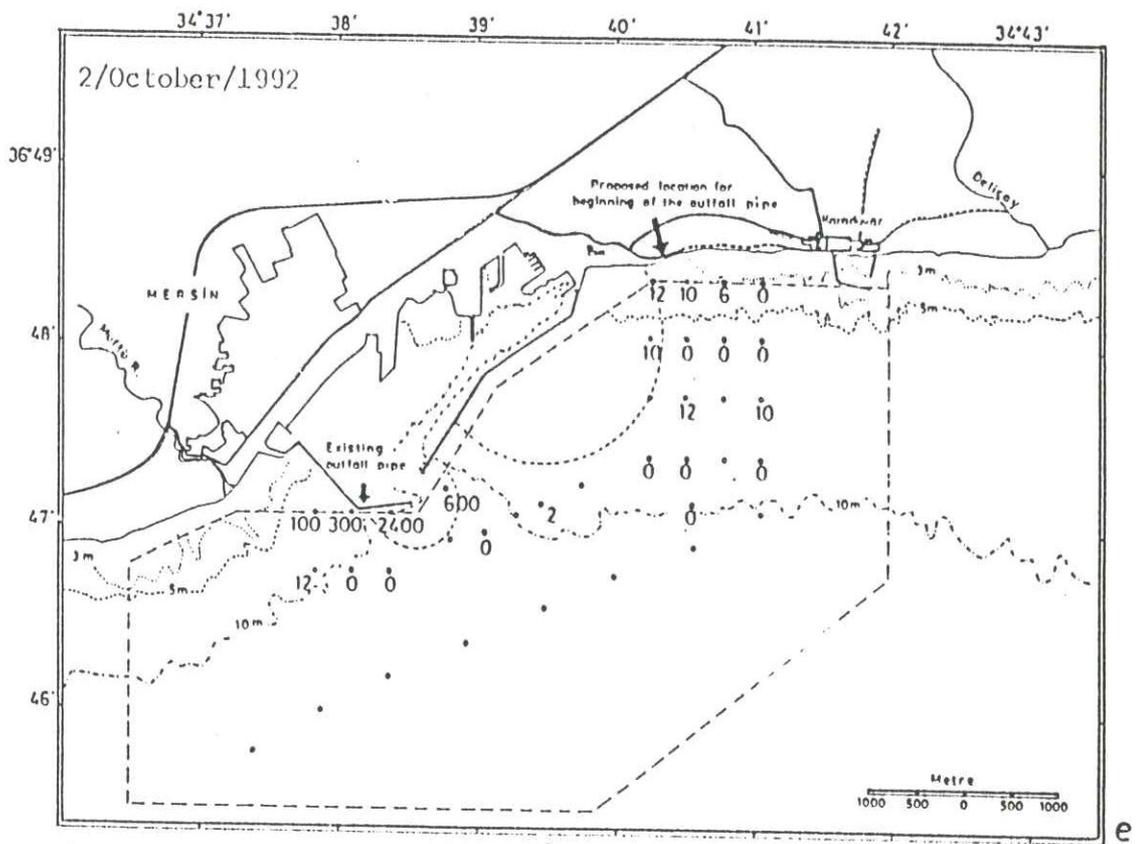
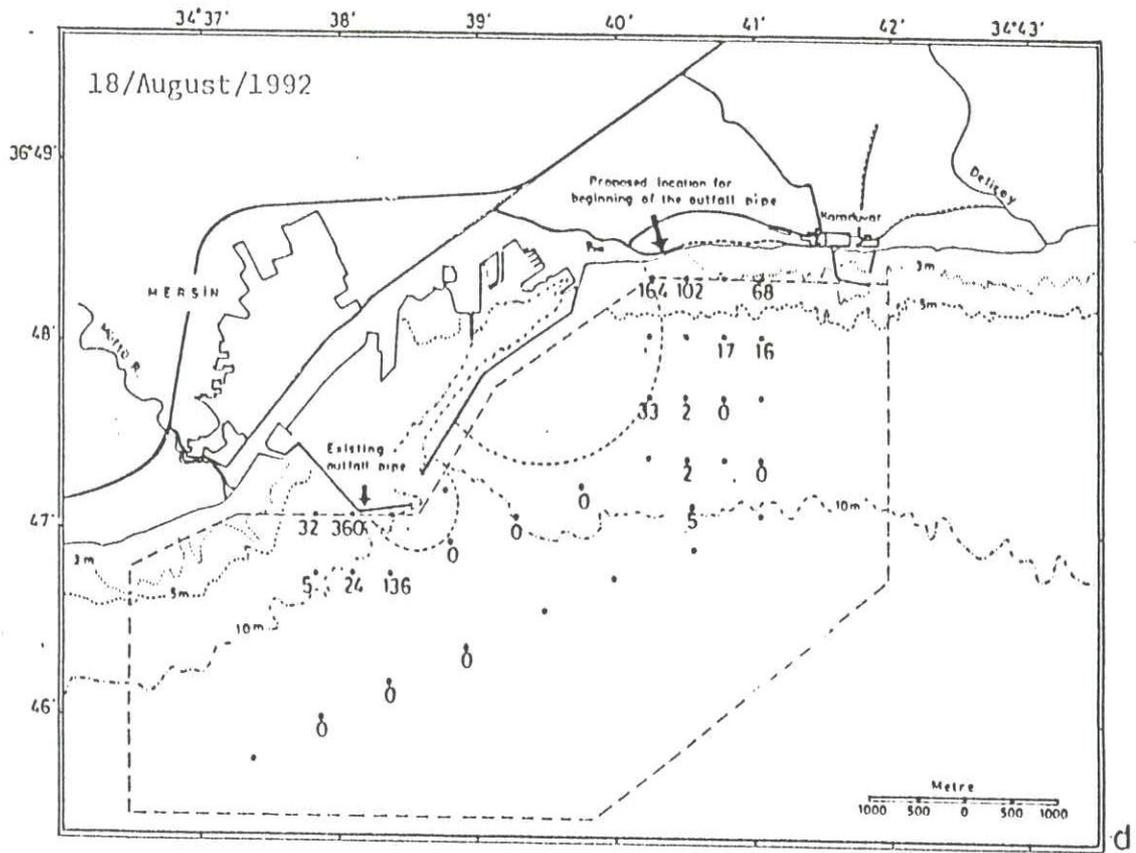


Figure II.10. continued

Table 11.1. Pollutants and biochemical parameters measured at three rivers and Mersin sewerage outlet.

Date: 3-12-1991													
Sta. No.	pH	DO (mg/L)	BOD ₅ (mg/L)	COD (mg/L)	TSS (mg/L)	o-PO ₄ (µM)	NO ₃ +NO ₂ (µM)	Tot-P (µM)	PAH (µg/L)	Hg (ng/L)	Cd (ng/L)	Cd-TSS (ng/L)	FC (#/100mL)
Delicay	7.67	7.6	3.3	102.7	6.9	0.06	253.4	---	11.76	0.9	1.52	20.9	1080
Cavuslu	7.64	6.9	1.9	119.8	3.2	20.3	412.2	---	0.89	0.6	0.19	N.D.	508
Muftu D.	8.28	9.9	2.8	239.7	3.1	0.06	131.8	---	0.41	3.0	N.D.	N.D.	540
Mersin D.	7.63	9.4	339.0	753.3	198.0	1.37	---	---	354.68	2.0	0.2	N.D.	1372x10 ⁶
Date: 27-2-1992													
Delicay	8.31	11.7	3.7	54.0	3.1	0.18	158.0	1.95	0.70	1.5	0.50	N.D.	150
Cavuslu	8.08	12.7	2.8	54.1	6.0	4.72	171.0	5.40	0.56	1.1	0.40	13.9	230
Muftu D.	8.96	9.5	2.3	103.0	1.2	0.61	75.4	0.83	1.07	1.4	0.10	N.D.	920
Mersin D.	7.37	8.7	175.0	398.7	63.0	63.20	153.3	166.00	253.14	2.5	1.31	138.4	800890
Date: 11-5-1992													
Delicay	8.14	10.2	2.2	369.6	9.8	0.48	72.98	0.53	3.13	2.2	2.85	14.9	1877
Cavuslu	7.67	6.8	8.2	---	9.1	10.85	96.87	13.70	0.62	1.1	1.19	N.D.	1776
Muftu D.	8.48	10.1	1.6	176.0	24.3	0.86	34.70	1.50	0.08	1.5	0.91	9.9	308
Mersin D.	7.38	8.5	132.0	193.6	101.3	182.00	151.20	193.50	157.84	1.9	4.41	238.1	222x10 ⁵
Date: 7-8-1992													
Sta. No.	pH	DO (mg/L)	BOD ₅ (mg/L)	COD (mg/L)	TSS (mg/L)	o-PO ₄ (µM)	NO ₃ +NO ₂ (µM)	Tot-P (µM)	PAH (µg/L)	Hg (ng/L)	Cd (ng/L)	Cd-TSS (ng/L)	FC (#/100mL)
Delicay	8.04	10.6	1.7	272.0	2.5	0.24	36.72	0.42	0.52	---	0.96	42.5	4250
Cavuslu	7.48	---	---	110.9	3.4	6.60	87.40	9.30	0.85	4.4	0.87	29.5	4000
Muftu D.	8.61	11.2	0.9	144.0	11.9	0.16	75.70	0.30	0.20	2.3	1.06	N.D.	1520
Mersin D.	7.36	7.9	18.5	320.0	125.0	124.8	5.60	128.0	21.91	4.1	1.49	398.2	4500000
Date: 29-9-1992													
Delicay	7.76	8.8	1.9	63.3	3.0	1.20	132.30	1.50	0.45	2.0	0.92	47.4	1100
Cavuslu	7.42	4.8	1.4	39.6	2.8	3.00	146.40	4.00	0.14	3.3	0.53	208.9	580
Muftu D.	8.26	11.9	1.6	79.0	2.6	1.60	6.40	---	0.02	3.9	0.77	7.4	680
Mersin D.	6.87	8.1	---	87.0	44.0	12.80	8.80	44.00	84.79	3.2	2.40	1198.1	17000
Date: 27-10-1992													
Delicay	8.18	8.1	3.9	32.2	1.0	0.55	43.50	0.70	1.96	---	1.16	818.4	1250
Cavuslu	7.50	6.1	2.3	16.1	3.9	2.00	45.60	2.25	0.06	3.4	1.22	265.4	750
Muftu D.	8.21	8.4	6.5	24.1	12.5	0.25	55.70	0.50	0.87	6.0	1.00	331.8	650
Mersin D.	7.22	8.8	266.3	273.3	70.7	42.00	8.60	52.00	15.86	8.4	2.03	3318.0	2700000

Table II.2. Hydrographical and biochemical parameters measured at coastal stations shown in Figure II.1. during December 1991 sampling period

Sta.No	Depth m	Date:5-12-1991	T °C	S (ppt)	pH	TSS (mg/L)	DG (mg/L)	BOD ₅ (mg/L)	COD (mg/L)	o-PD ₄ (µM)	NO ₃ +NO ₂ -N (µM)	SD (m)	FC (#/100mL)
M-1	0		15.88	38.2	8.08	10.9	7.03	0.65	1.60	0.45	23.32	---	100
M-2	0		15.90	38.3	8.13	9.5	7.14	0.59	2.47	0.05	11.28	---	98
M-3	0		15.88	38.2	8.13	10.1	7.14	0.51	2.25	0.23	9.10	---	192
M-4	0		17.97	38.6	8.15	13.0	7.07	0.59	2.18	0.53	5.13	---	218
M-5	0		17.43	38.6	8.20	18.1	7.25	0.39	2.11	0.02	1.19	---	7
M-6	0		17.89	38.6	8.19	6.3	7.30	0.73	4.87	0.04	1.44	---	4
M-7	0		17.80	38.7	8.20	22.9	7.30	0.49	1.81	0.03	0.96	---	4
M-8	0		18.36	38.7	8.20	18.1	7.31	0.58	1.82	0.02	1.51	---	---
M-9	0		18.31	38.6	8.20	11.9	7.27	0.51	1.50	0.03	0.80	---	4
M-10	0		18.14	38.6	8.20	20.1	7.36	0.62	1.16	0.11	1.44	---	---
M-11	0		18.16	38.5	8.20	5.7	7.32	0.55	1.45	0.02	0.45	---	4
M-12	0		18.24	38.5	8.19	16.2	7.29	0.70	2.40	0.03	1.09	---	---
M-13	0		18.35	38.6	8.18	16.1	7.32	0.57	1.67	0.03	0.96	---	2
M-13	5		17.92	38.6	8.19	---	7.30	0.54	---	0.25	0.99	---	---
M-14	0		18.42	38.6	8.18	15.3	7.31	0.63	2.25	0.05	0.99	---	---
M-15	0		18.39	38.6	8.20	4.3	7.31	0.36	2.64	0.05	1.22	---	2
M-16	0		18.48	38.6	8.20	4.1	7.33	0.58	2.62	0.29	0.93	---	2
M-17	0		19.22	38.9	8.18	3.5	7.25	0.69	2.62	0.03	1.25	---	---
M-17	5		18.92	38.9	---	---	7.28	0.90	---	0.03	1.15	---	---
M-18	0		17.97	38.7	8.14	14.5	6.55	0.57	2.84	0.73	6.54	---	124
M-19	0		18.14	38.7	8.14	8.1	6.68	2.63	5.01	1.10	5.42	---	3000000
M-20	0		17.91	38.7	8.10	---	6.06	1.80	2.38	0.53	8.34	---	150
M-21	0		18.36	38.8	8.20	---	7.30	0.50	---	0.02	0.93	---	---
M-22	0		18.78	38.8	8.20	---	7.50	0.73	1.89	0.03	0.83	---	12
M-22	5		18.25	38.7	8.15	---	7.48	0.80	---	0.03	3.55	---	---
M-23	0		19.03	38.9	8.19	3.4	7.54	0.71	1.60	0.02	1.09	---	6
M-24	0		---	---	8.18	19.5	7.12	0.47	---	---	---	---	0
R-1	0		19.23	38.9	8.18	19.5	6.37	0.47	0.95	0.02	0.90	---	---

Table II.3. Hydrographical and biochemical parameters measured at coastal stations shown in Figure II.1. during April 1992 sampling period

Sta.No	Depth (m)	T °C	S (ppt)	pH	TSS (mg/L)	DO (mg/L)	BOD ₅ (mg/L)	COD (mg/L)	o-PG ₄ (µM)	NO ₃ +NO ₂ -N (µM ²)	SD (m)	FC (#/100mL)
M-1	0	18.80	---	8.28	5.1	10.21	3.85	4.1	0.56	1.68	2.5	202
M-2	0	19.65	---	8.26	18.9	9.64	4.26	5.5	0.30	0.66	2	10
M-3	0	19.80	---	8.28	16.2	9.63	3.12	3.9	0.07	2.13	2	0
M-4	0	19.60	---	8.33	16.4	9.51	4.32	6.5	0.25	2.74	3	0
M-5	0	19.85	---	8.29	13.5	9.08	3.52	4.8	0.09	5.03	2.5	0
M-6	0	19.85	---	8.24	11.2	8.36	2.13	5.1	0.16	0.61	2.2	4
M-7	0	19.85	---	8.24	3.3	9.20	2.07	4.0	0.15	0.38	2	0
M-8	0	19.90	---	8.27	13.4	8.37	2.78	3.2	0.19	0.69	2	4
M-9	0	19.90	---	8.23	16.2	8.37	1.95	3.5	0.08	0.18	2.5	0
M-10	5	19.85	---	8.11	---	---	---	---	0.16	0.20	---	---
M-10	0	22.00	---	8.21	15.6	8.66	2.22	2.9	0.09	1.27	3	4
M-11	5	19.90	---	8.10	---	---	---	---	0.08	0.41	---	---
M-11	0	22.00	---	8.22	5.4	8.93	2.14	3.7	0.02	0.15	2.5	4
M-12	5	19.90	---	8.12	---	---	---	---	0.32	0.25	---	---
M-12	0	20.05	---	8.21	7.8	8.46	2.76	4.4	0.07	0.41	2.5	8
M-13	0	19.90	---	8.17	---	---	---	---	0.29	0.25	---	---
M-13	5	20.00	---	8.16	16.9	6.53	1.42	1.5	0.25	0.30	3.5	12
M-14	0	19.90	---	8.10	---	---	---	---	0.03	0.25	---	---
M-14	5	19.95	---	8.20	12.0	8.46	1.10	4.4	0.02	0.15	3	32
M-15	0	19.90	---	8.16	---	---	---	---	---	---	---	---
M-15	5	21.00	---	8.08	10.9	8.53	1.50	1.6	0.02	0.15	3.5	30
M-16	0	19.90	---	8.10	---	---	---	---	0.02	0.86	---	---
M-16	5	22.00	---	8.14	5.1	8.68	1.32	23.9	0.02	0.30	3.5	50
M-17	0	19.95	---	8.15	---	---	---	---	0.02	0.15	---	---
M-17	5	19.95	---	---	4.1	8.56	1.16	21.4	0.02	0.86	3	240
M-18	0	20.00	---	8.13	13.2	8.83	3.51	19.1	0.02	0.38	---	---
M-18	5	20.00	---	---	---	---	---	---	12.20	16.80	2	4532
M-19	0	21.00	---	8.22	5.3	8.71	1.51	18.9	0.04	1.42	1.5	900
M-20	0	21.00	---	8.15	---	---	---	---	0.05	0.35	---	---
M-20	5	20.05	---	8.16	13.2	9.27	3.03	3.8	10.01	4.97	1.5	100
M-21	0	20.00	---	8.16	---	---	---	---	0.10	0.29	---	---
M-21	5	19.80	---	8.15	4.4	8.47	1.06	1.9	---	---	3	20
M-22	0	21.00	---	8.13	13.1	9.23	2.53	3.8	---	---	---	---
M-22	5	20.00	---	8.16	---	---	---	---	---	---	2.5	0
M-23	0	20.00	---	8.13	---	---	---	---	---	---	---	---
M-23	5	23.00	---	8.14	17.0	8.91	1.96	2.4	0.17	0.30	2.5	25
R-1	0	---	---	8.08	---	---	---	---	0.35	1.27	---	---
R-1	5	---	---	8.06	2.8	---	1.33	2.6	0.02	1.68	3.5	8

Table II.4. Hydrographical and biochemical parameters measured at coastal stations shown in Figure II.1. during May 1992 sampling period

Sta.No	Depth m	T °C	S (ppt)	pH	TSS (mg/L)	DO (mg/L)	BOD ₅ (mg/L)	COD (mg/L)	o-PO ₄ (μM)	NO ₃ +NO ₂ -N (μM)	SD (m)	FC (#/100mL)
M-1	0	---	---	8.22	8.5	7.30	0.35	5.11	0.15	24.28	2	25
M-2	0	---	---	8.22	10.4	7.38	1.98	3.11	0.18	24.86	2	10
M-3	0	---	---	8.23	8.9	7.40	1.45	3.15	0.17	36.20	2	---
M-4	0	---	---	8.21	8.0	7.48	1.68	2.20	0.20	35.80	2	22
M-5	0	23.87	34.4	8.23	8.4	7.68	1.90	2.80	0.25	29.20	2	22
M-6	0	23.80	34.5	8.20	5.6	7.46	1.85	2.80	0.18	27.16	2	5
M-7	0	24.02	33.9	8.25	5.0	7.85	2.06	3.04	0.16	24.17	2	---
M-8	0	23.69	35.7	8.20	5.2	7.85	2.06	2.37	0.15	17.59	2.5	23
M-9	0	23.26	36.9	8.24	8.2	7.93	2.48	4.30	0.13	13.68	2.5	19
M-10	0	23.15	36.8	8.20	8.8	7.94	2.16	4.30	0.13	11.21	2.5	21
M-11	0	23.11	36.8	8.23	7.0	7.96	1.98	2.96	0.12	16.36	2.5	5
M-12	0	23.33	36.5	8.22	7.6	7.57	1.77	---	0.11	11.83	2.5	16
M-13	0	23.37	36.9	8.22	6.7	7.42	1.17	---	0.09	0.93	2.5	20
M-14	0	---	---	8.22	5.0	7.69	2.09	2.80	0.11	1.95	3.5	---
M-15	5	---	---	8.20	---	7.81	1.65	---	0.10	0.62	---	---
M-16	5	---	---	8.19	24.4	7.50	1.17	---	0.11	1.75	3.5	19
M-17	0	26.01	37.2	8.23	7.2	7.63	1.79	---	0.08	7.51	---	4
M-18	5	---	---	8.22	---	7.75	1.90	2.20	0.15	0.77	---	---
M-19	0	23.00	37.3	8.21	4.7	7.82	1.81	---	0.11	7.10	4	10
M-20	0	22.37	37.6	---	---	7.87	2.12	3.10	0.10	7.92	---	---
M-21	0	24.04	35.5	---	---	7.40	1.17	---	0.08	0.99	---	---
M-22	0	23.78	36.5	8.21	8.6	---	---	3.14	0.20	23.88	2.5	150
M-23	0	23.93	36.6	8.24	6.3	7.60	2.35	---	0.16	27.16	2.5	16
M-24	0	23.74	36.4	---	8.1	7.41	2.06	---	0.18	23.44	2.5	4
M-25	0	23.30	36.6	---	---	---	---	---	---	---	---	---
M-26	0	23.70	35.1	8.25	16.4	7.94	2.65	---	0.17	23.88	2.5	16
M-27	5	23.92	35.9	8.25	15.4	7.12	1.88	2.71	0.29	25.92	2.5	400
M-28	0	23.49	37.1	8.25	9.5	7.78	---	---	0.24	30.84	3	3
M-29	0	23.91	36.8	8.18	7.6	---	---	---	0.21	24.28	3	---
M-30	0	23.59	37.1	8.22	---	---	---	---	0.10	10.59	---	---
M-31	0	23.86	36.9	8.22	7.1	7.05	0.98	1.70	0.08	6.07	3.5	5
M-32	0	---	---	8.21	4.8	---	---	0.80	0.05	0.07	---	---
M-33	0	---	---	8.21	---	---	---	---	0.19	1.34	3	---
M-34	0	23.80	36.8	8.20	2.6	---	---	---	0.11	6.17	3	---
M-35	0	26.69	36.8	8.21	4.7	7.40	---	---	0.28	6.48	3	---
M-36	0	---	---	8.22	7.6	7.30	---	---	0.09	0.31	4	20
M-37	0	24.05	36.2	8.20	5.4	7.19	---	---	0.11	32.08	3.5	---
M-38	0	23.89	36.7	8.22	11.1	7.61	---	1.30	0.09	0.26	3.5	---
M-39	0	---	---	---	---	---	---	2.50	0.10	0.51	3	---
M-40	0	---	---	---	---	---	---	---	0.08	2.26	3	0

Table II.5. Hydrographical and biochemical parameters measured at coastal stations shown in Figure II.1. during August 1992 sampling period

Sta.No	Depth m	T °C	S (ppt)	pH	TSS (mg/L)	DO (mg/L)	BOD ₅ (mg/L)	COD (mg/L)	O-PO ₄ (µM)	NO ₃ +NO ₂ -N (µM) ²	SD (m.)	FC (#/100mL)
M-1	0			8.08	13.6	10.74	1.55	3.41	3.16	0.44	2	164
M-2	0			8.10	9.5	9.04	1.88	4.13	0.54	0.65	2	102
M-3	0			8.09	17.3	9.32	3.17	7.02	0.29	0.60	2	
M-4	0			8.12	14.0	8.63	2.40	4.68	0.17	2.17	2	68
M-5	0	29.44	36.0	8.13	5.2	7.64	1.80	3.90	0.22	0.38	2	16
M-6	0	29.87	35.3	8.16	8.6	8.93	0.87	1.34	0.23	0.43	2	17
M-7	0	30.04	35.7	8.19	7.0	6.97	1.00	1.76	0.26	0.43	2	
M-8	0	29.53	35.5	8.22	7.0	7.98	1.50	3.71	0.29	0.87	2	2.5
M-9	0	29.91	36.5	8.15	3.3	6.97	3.55	7.99	0.95	0.65	2	33
M-10	0	29.89	36.4	8.19	8.5	7.98	1.28	2.25	0.24	0.54	2	2
M-11	0	29.98	36.3	8.19	16.0	7.45	0.86	1.56	0.20	0.27	2	0
M-12	5	29.68	38.2	8.04					0.27	0.13		0
M-13	5	29.89	36.2	8.21	7.4	7.05	1.45	2.73	0.18	0.57	2	
M-14	0	29.62	38.3	8.03					0.18	0.33		
M-15	5	29.99	36.8	8.05	14.6	7.70	2.35	4.42	0.14	0.22	2	0
M-16	0	29.58	38.4						0.24	0.22		0
M-17	0	29.89	37.1	8.22	12.7	7.56	2.65	5.86	8.68	0.64	2	
M-18	0	29.84	37.3	8.22	7.3	7.28	2.58	5.00	0.22	18.21	2	2
M-19	5	29.65	37.4	8.19					0.21	0.33		10
M-20	0	29.86	37.3	8.23	18.8	6.89	1.95	5.63	0.03	0.54	2	5
M-21	0	29.98	38.1	8.31		6.66	2.75		0.69	0.16		2
M-22	5	29.59	38.5	8.19					0.14	0.11		
M-23	0	29.94	35.9	8.33	61.0	10.76	10.31	22.43	1.82	1.08	0.5	
M-24	0	30.66	35.8	8.31	33.3	10.85	2.96	4.69	1.94	6.63		360
M-25	0	30.47	36.6	8.28	120.0	11.90	5.81	13.02	4.56	11.96		32
M-26	0	30.28	37.0	8.32		9.49	4.20		0.44	1.32		5
M-27	0	30.24	36.6	8.36	16.0	10.56	3.10		6.06	1.10		24
M-28	0	30.52	36.5	8.30		11.35	3.36	8.23	1.60	0.33		136
M-29	0	30.07	36.0	8.36		10.26	3.12	6.54	4.48	0.88		
M-30	5	29.07	38.3						1.64	0.88		
M-31	0	29.67	38.0	8.26	26.0	8.22			6.06	0.44		
	5			8.23	32.5		2.50	4.30	6.48	8.68		
	0			8.07					0.27	0.33		
	0	30.19	36.7	8.25	15.5			14.90	0.97	0.43		
	0	29.74	38.0	8.22		7.62	2.90		1.25		2.5	
	0	29.59	38.1	8.12		7.13	1.41		2.12			
	0	29.60	38.0	8.14		6.82	1.94					
	0	29.64	38.0	8.26		11.05	6.14				2.5	

Table II.6. Hydrographical and biochemical measured at coastal stations shown in Figure II.1. October 1992 sampling period

Date: 2-10-1992		T	S	PH	TSS	DO	BOD ₅	COD	o-PO ₄	NO ₃ +NO ₂ -N	SD	FC
Sta.No	Depth	°C	(ppt)		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(µM)	(µM)	(m)	(#/100mL)
	m											
M-1	0	---	---	8.14	7.3	5.94	0.64	---	0.11	0.27	---	12
M-2	0	---	---	8.14	12.2	6.29	1.07	1.69	1.72	27.11	---	10
M-3	0	---	---	8.03	17.9	6.24	0.81	2.11	9.32	10.85	---	6
M-4	0	---	---	8.00	19.9	6.32	0.80	2.17	20.32	10.52	---	0
M-5	0	25.31	39.3	8.14	10.9	6.08	0.65	0.74	1.45	2.98	---	0
M-6	0	25.82	39.3	8.13	10.3	5.64	0.35	0.52	1.26	0.54	---	0
M-7	0	25.62	39.5	8.14	11.6	5.88	0.28	1.23	0.16	0.43	---	0
M-8	0	25.93	39.2	8.15	19.8	5.89	0.36	1.51	0.15	0.43	---	10
M-9	0	26.04	39.4	8.15	16.2	5.80	0.14	1.40	0.12	0.54	---	---
M-10	0	26.00	39.2	8.14	21.9	6.15	0.18	1.58	0.16	13.12	---	12
M-11	0	25.99	39.4	8.15	13.4	5.94	0.24	0.85	0.19	0.54	---	---
M-12	5	25.82	39.5	8.15	19.5	---	---	---	0.07	0.54	---	---
M-13	5	26.19	39.4	8.14	19.9	5.86	0.03	2.16	0.06	0.54	---	10
M-14	5	25.71	39.4	8.15	26.4	---	---	---	0.09	0.54	---	70
M-15	0	26.21	39.4	8.14	18.9	5.74	0.15	4.41	0.02	0.22	---	0
M-16	5	25.97	39.5	8.14	19.8	---	---	---	0.03	0.33	---	20
M-17	5	26.24	39.5	8.14	---	5.70	---	4.49	0.02	0.22	---	---
M-18	0	26.03	39.5	8.14	---	---	---	---	0.02	0.33	---	0
M-19	0	26.36	39.4	8.14	18.7	5.74	0.02	2.25	0.04	0.22	---	---
M-20	5	26.07	39.5	8.13	---	---	---	---	0.02	0.22	---	---
M-21	0	26.37	39.4	8.14	---	5.63	---	0.82	0.03	0.22	---	---
M-22	5	26.09	39.5	8.14	---	---	---	---	0.05	0.33	---	---
M-23	0	26.44	39.5	8.14	17.8	5.62	---	2.01	0.02	0.22	---	0
M-24	0	25.94	39.4	8.02	5.9	5.60	0.55	2.40	0.20	1.52	---	2400
M-25	5	25.63	39.4	8.00	21.9	5.93	0.05	---	0.30	1.08	---	---
M-26	0	25.71	39.4	8.03	16.2	5.85	0.28	3.49	0.17	0.65	---	300
M-27	5	25.56	39.4	8.02	48.5	5.75	0.10	---	0.37	1.52	---	---
M-28	0	25.76	39.4	8.05	16.0	5.29	0.96	3.84	0.67	1.30	---	100
M-29	5	25.66	39.4	8.04	---	---	---	---	---	---	---	---
M-30	0	26.38	39.5	8.05	13.4	---	---	0.37	0.10	0.43	---	12
M-31	5	26.09	39.5	8.04	---	---	---	---	0.07	0.33	---	---
M-32	0	26.39	39.5	8.08	---	---	---	2.09	0.06	0.22	---	0
M-33	5	26.09	39.5	8.08	---	---	---	---	0.03	0.22	---	---
M-34	0	26.35	39.5	8.09	19.2	6.00	0.10	---	0.03	0.22	---	0
M-35	5	26.02	39.5	8.09	---	5.77	0.11	---	0.03	0.42	---	---
M-36	0	25.48	39.2	8.08	7.1	6.88	1.28	2.01	0.33	0.65	---	600
M-37	5	25.71	39.4	8.00	---	5.35	0.51	---	0.29	1.08	---	---
M-38	0	26.54	39.5	8.06	12.6	5.95	0.29	---	---	---	---	0
M-39	5	26.16	39.5	8.05	13.3	5.66	0.05	---	---	---	---	2

