!BSTRACT—4HE INCREASE IN THE ABUN
DANCE OF GRAY SNAPPER ,UTJANUS GRI
SEUS IN 4EXAS BAYS AND ESTUARIES
OVER THE PAST YEARS IS CORRELATED
TO INCREASED WINTERTIME SURFACE WATER
TEMPERATURES 4RENDS IN THE RELATIVE
ABUNDANCE OF GRAY SNAPPER ARE EVALU
ATED BY USING MONTHLY FISHERY INDE
PENDENT MONITORING DATA FROM EACH OF
THE SEVEN MAJOR ESTUARIES ALONG THE
4EXAS COAST FROM THROUGH
%NVIRONMENTAL CONDITIONS DURING
THIS PERIOD DEMONSTRATED INCREAS
ING ANNUAL SEA SURFACE TEMPER LORING
THIQ Èa˜D• V@F 0T CVC0 GV@Èp 0LNV@ING CONDITIONS FOR T
JUVENILES AND INCREASED RECRUITMENT
SUCCESS)N THE ABSENCE OF COLD WIN
TERS THIS SPECIES HAS ESTABLISHED
SEMIPERMANENT ESTUARINE POPULA
TIONS ACROSS THE ENTIRE 4EXAS COAST
! SHIFT TO NEGATIVE PHASES OF THE .ORTH
!TLANTIC /SCILLATION WILL LIKELY RESULT
IN RETURNS TO COLDER WINTER TEMPERA
TURE MINIMUMS THAT COULD REVERSE
ANY RECENT POPULATION GAINS

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4HE VIEWS AND OPINIONS EXPRESSED
OR IMPLIED IN THIS ARTICLE ARE THOSE
OF THE AUTHOR AND DO NOT NECESSARILY
REmECT THE POSITION OF THE .ATIONAL
-ARINE &ISHERIES 3ERVICE ./!!

!RCOS ET AL 3MITH AND
&EW STUDIES HAVE EXAM
THE LINK BETWEEN ECOSYSTE
TURE FISHERIES PRODUCTION
MATIC FORCING ALONG THE SO
COASTS OF THE 5NITED 3TATE
ING hTHE 'ULFv OF -EXICO HE
REFERRED TO AS hTHE GULFv
THAT HAVE 0ARKER AND $IXO
3ULLIVAN ET AL GENERAL
TIFY WARMER WINTER TEMPERA
THE CAUSE OF DISTRIBUTIONAL
ISH POPULATIONS /VIATT
TON

4HE GRAY SNAPPER ,UTJANUS GRI
SEUS IS A TEMPERATE AND TROP
ISH COMMONLY FOUND IN MAR
ESTUARINE WATERS IN THE WE
LANTIC /CEAN FROM &LORIDA
"RAZIL INCLUDING "ERMUDA TH
BEAN AND THE NORTHER

ALENT IN CONTINENTAL AND IS
WATERS IN THE VICINITY OF SO
DA #UBA AND 6ENEZUELA !LLM
'RIMES ,ARVAE AND JUV
ISH ARE COMMON INSHORE IN S
AND MANGROVE NURSERY ARE
HAVE BEEN EVEN FOUND IN FR
ESTUARIES !DULTS ARE USUAL
ATED WITH COMPLEX STRUCTUR
ROCKY AREAS CORAL REEFS
DOCKS AND MANGROVE SLOUG
ING THEM THE OFTEN USED LO

4ABLE

.UMBERS OF GRAY SNAPPER ,UTJANUS GRISEUS COLLECTED BY EACH OF THE ISHERY INDE ALONG THE 4EXAS COAST 4HE INCREASE IN NUMBERS OF GRAY SNAPPER FROM BEFORE T X FOLD INCREASE

%STUARY	"AG SEINE "EFORE	"AG SEINE !FTER	"AG SEINE X FOLD INCREASE	/TTER TRAWL "EFORE	/TTER TRAWL !FTER	/TTER TRAWL X FOLD INCREASE	'ILL NET "EFORE	'ILL NET !FTER	'ILL NET X FOLD INCREASE
3ABINE .ECHES		ˆ			ˆ			ˆ	
4RINITY 3AN *ACINTO					ˆ				
,AVACA #OLORADO									
'UADALUPE									
-ISSION !RANSAS									
.UECES					ˆ				
5PPER ,AGUNA -ADRE					ˆ				
,OWER ,AGUNA -ADRE									
4OTAL									

COLLECTED EACH MONTH IN EACH BAY EXCEPT 3ABINE ,AKE 3ABINE ,AKE SAMPLING BEGAN IN &ROM !UGUST THROUGH *ANUARY SAMPLING FREQUENCY WITHIN EACH ESTUARY INCREASED TO SAMPLES PER MONTH THEN TO PER MONTH AND INALLY TO SAMPLES EACH MONTH 3INCE A TOTAL OF BAG SEINE SAMPLES HAVE BEEN COLLECTED FROM RANDOMLY SELECTED LOCATIONS WITHIN EACH BAY IN EACH MONTH RESULTING IN SAMPLES PER YEAR /TTER TRAWLS M WIDE AND WITH CM STRETCHED NYLON

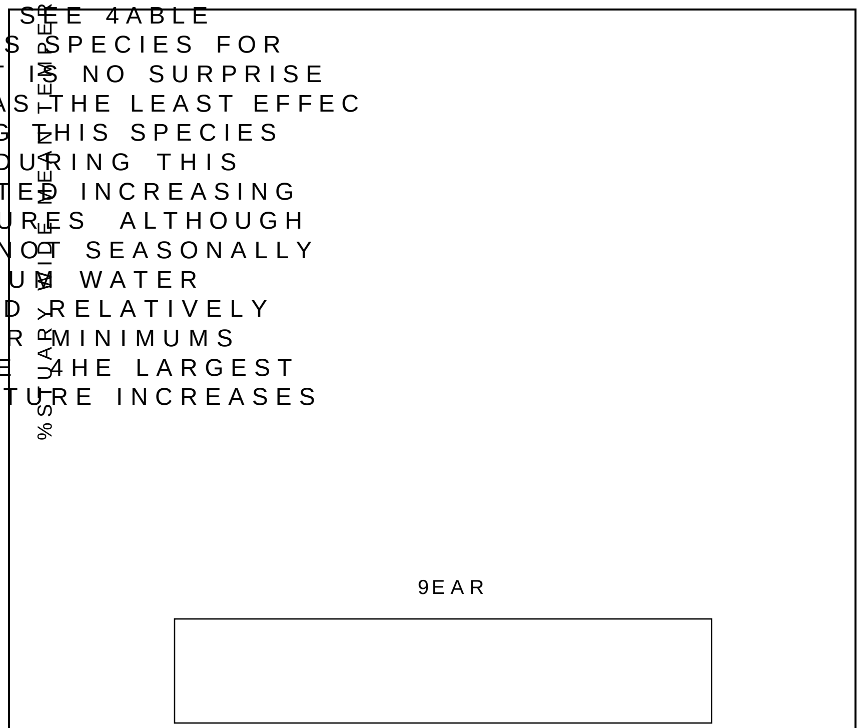
4ABLE

0ERCENT AND CUMULATIVE PERCENT OF THE TOTAL VARIATION EXPLAINED BY THE EIGHT
EIGHT MODES CORRESPOND TO THE EIGHT MAJOR 4EXAS ESTUARIES SPATIALLY INTERPOL
MEANS OF A SERIES CONSISTING OF MONTHLY AVERAGED MEAN SALINITY READINGS COL
THE 4EXAS 0ARKS AND 7ILDLIFE $EPARTMENT

	%/&
0ERCENT	
#UMULATIVE PERCENT	

TO THE .UECES %STUARY SEE 4ABLE 'IVEN THE AFINITY OF THIS SPECIES FOR STRUCTURED HABITATS IT IS NO SURPRISE THAT THE OTTER TRAWL WAS THE LEAST EFFEC TIVE GEAR FOR CAPTURING THIS SPECIES

%NVIRONMENTAL DATA DURING THIS SAME PERIOD DEMONSTRATED INCREASING ANNUAL WATER TEMPERATURES ALTHOUGH THESE INCREASES WERE NOT SEASONALLY UNIFORM 3UMMER MAXIMUM WATER TEMPERATURES REMAINED RELATIVELY STABLE WHEREAS WINTER MINIMUMS INCREASED THROUGH TIME 4HE LARGEST PROPORTION OF TEMPERATURE INCREASES



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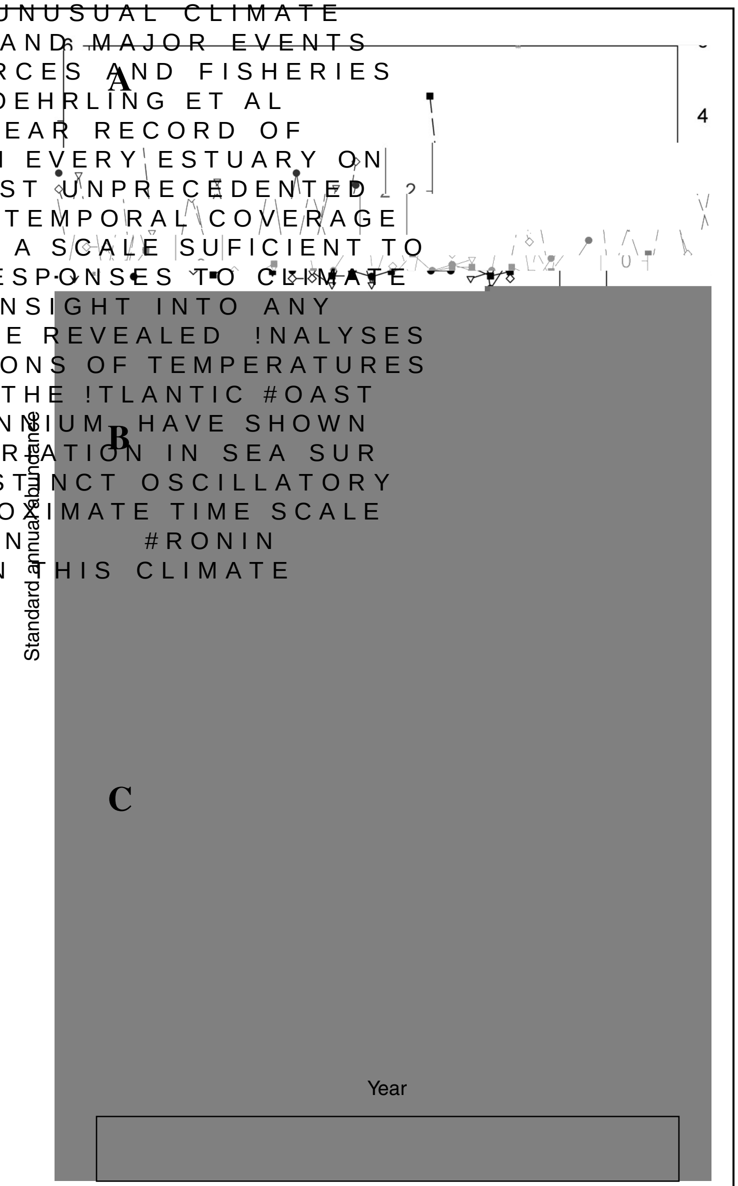
4IME SERIES OF MEAN YEARLY TEMPERATURES SUMMER
MINIMUMS IN # OF 4EXAS COASTAL ESTUARIES 4HE SOL
TIFIES THE LOWER LETHAL LIMIT # FOR GRAY SNAPPE

DURING RECENT YEARS WHEN UNUSUAL CLIMATE TRENDS HAVE BEEN REPORTED AND MAJOR EVENTS HAVE AFFECTED LIVING RESOURCES AND FISHERIES MANAGEMENT 2EBSTOCK 7OEHRLING ET AL

4HE UNINTERRUPTED YEAR RECORD OF SYSTEMATIC MONITORING WITHIN EVERY ESTUARY ON THE 4EXAS 'ULF COAST IS ALMOST UNPRECEDENTED IN TERMS OF BOTH SPATIAL AND TEMPORAL COVERAGE 4HESE COLLECTIONS ENCOMPASS A SCALE SUFICIENT TO DOCUMENT ECOSYSTEM LEVEL RESPONSES TO CLIMATE VARIATION AND MAY PROVIDE INSIGHT INTO ANY BIOLOGICAL RESPONSES THAT ARE REVEALED !NALYSES OF PROXY BASED RECONSTRUCTIONS OF TEMPERATURES WITH PARTICULAR EMPHASIS ON THE !TLANTIC #OAST REGION DURING THE PAST MILLENNIUM HAVE SHOWN PATTERNS OF MULTIDECADAL VARIATION IN SEA SUR FACE TEMPERATURE WITH A DISTINCT OSCILLATORY MODE OF VARIATION AT AN APPROXIMATE TIME SCALE OF YEARS $ELWORTH AND -ANN #RONIN ET AL %MBEDDED WITHIN THIS CLIMATE



&IGURE
4IME SERIES OF YEARLY CATCH RATES FOR GRAY *Lutjanus griseus* GRISEUS !WITH BAG SEINES "OTTER TRAWLS #GILLNETS FROM FOUR MID COAST 4EXAS ESTUARIES 4O ALL SONS EACH SERIES HAS BEEN STANDARDIZED TO A UNIT VARIANCE OF

AND !BLE PRESENTED FOR WHAT THE AUTHORS TERM AS hOUTBURSTSv OF !TLANTIC CROAKER -ICROPOGONIAS UN DULATUS POPULATIONS ALONG THE EAST COAST OF THE 5NITED 3TATES 7ARMER WINTERS RESULT IN HIGHER JUVENILE SUR VIVAL WHICH ALLOWS FOR THE FORMATION OF LARGER YEAR CLASSES 3EQUENTIAL WARM WINTERS LEAD TO SEQUENTIALLY LARGE YEAR CLASSES THAT EXTEND THE DURATION OF AN OUT BURST)N THE !TLANTIC CROAKER EXAMPLE THE OUTBURST ALLOWED POPULATION RANGES TO EXPAND NORTH AND AS A RESULT SPAWNING EXTENDED FARTHER NORTH SUPPLYING

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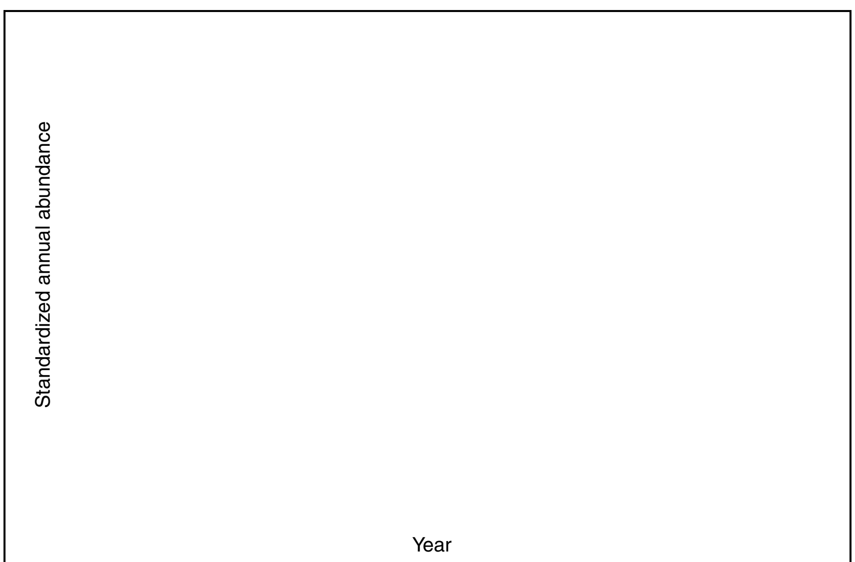

&IGURE
4IME SERIES OF LANDING OF ADULT GRAY SNAPPER ,UTJANUS GRISEUS FROM GILL NETS 4EXAS ESTUARIES AND RECREATIONAL LANDINGS BOTH 4EXAS AND ,OUISI ANA FROM TO 4O ALLOW DIRECT COMPARISONS EACH SERIES HAS BEEN STANDARDIZED TO A MEAN OF ZERO AND A UNIT VARIANCE OF

THE LIFE HISTORY BEHAVIOR AND POPULATION DYNAMICS OF THE AFFECTED ANIMALS -C%ACHRON ET AL $URING OUR STUDY PERIOD THREE SEVERE POLAR COLD FRONTS CAUSED COAST WIDE ISH KILL EVENTS DURING $ECEMBER &EB RUARY AND $ECEMBER)N THE ABSENCE OF COLD WINTERS THIS SPECIES HAS ESTABLISHED SEMIPERMANENT POPULATIONS IN NEARLY EVERY ESTUARY ALONG THE 4EXAS COAST AND THESE POPULATIONS ARE LIKELY TO CONTINUE TO mOURISH UNTIL THE NEXT POLAR FRONT EITHER DIMINISHES THESE ESTUARINE POPULATIONS OR A SERIES OF SUCCESSIVE COLD WINTERS CREATES A hTHERMAL CLOSUREv OF THE NURSERY HABITATS (ARE AND !BLE 'RAY SNAPPER ARE FAR LESS ABUNDANT IN THE NORTHERNMOST ESTUARY 3A

-C%ACHRON , 7 ' # -ATLOCK # % "RYAN 0 5NGER 4 *
#ODY AND * (-ARTIN
7INTER MASS MORTALITY OF ANIMALS IN 4EXAS BAYS
.ORTHEAST 'ULF 3CI n
-OORE 2 (
/CCURRENCE OF TROPICAL MARINE FISHES AT 0ORT !RAN
SAS 4EXAS n RELATED TO SEA TEMPERATURES #O
PEIA n
/BSERVATIONS ON FISHES KILLED BY COLD AT 0ORT
!RANSAS 4EXAS n *ANUARY 3OUTHWEST .AT
n
.IXON 3 ' " ! "UCKLEY - ,AMONT AND " 2OWELL
! ONE HUNDRED AND SEVENTEEN YEAR COASTAL WATER
TEMPERATURE RECORD FROM 7OODS (OLE -ASSACHUSETTS %S
S R D¢à
TT 0•(R