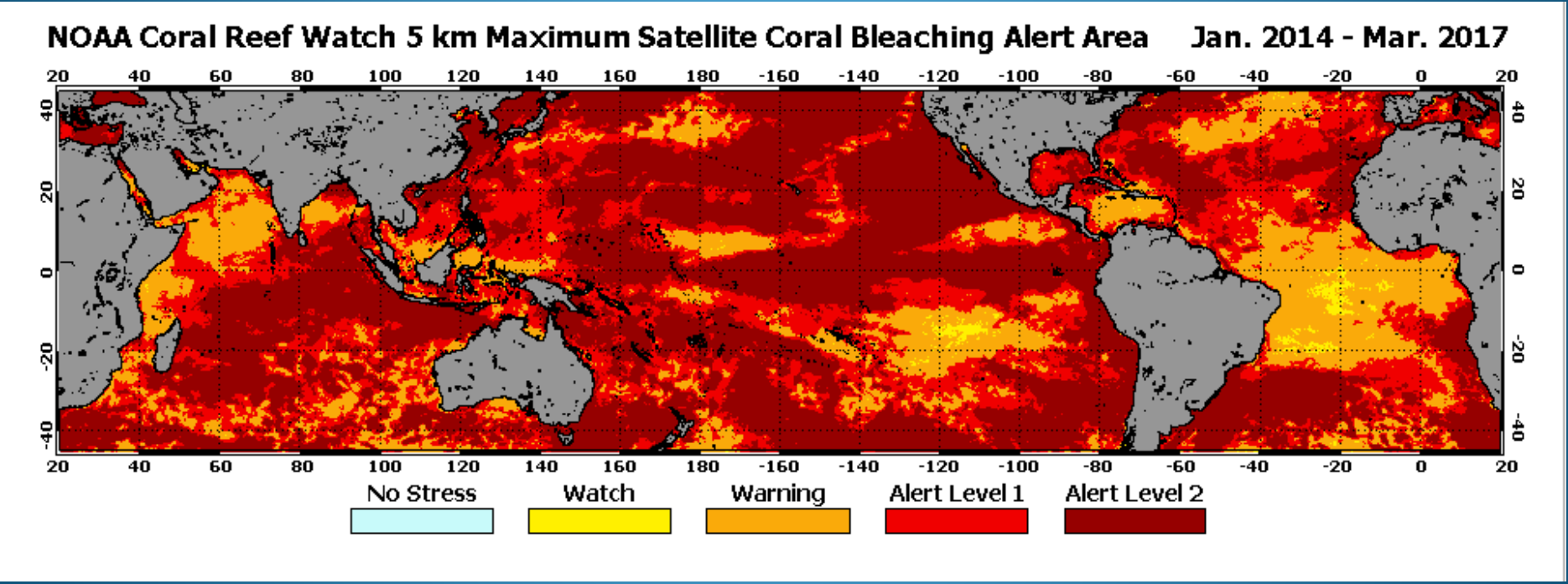
2016年夏季高水温による大規模白化現象

～国際サンゴ礁イニシアチブ等の国際的な対応について～



(“Progression of the Ongoing Global Coral Bleaching Event”, Coral Reef Watch, NOAA)より抜粋

一般財団法人　自然環境研究センター　木村　匡

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内容

1. 世界のサンゴ礁白化現象の経過
2. 白化レポート：白化状況のとりまとめ
3. 各国の対応
4. 国際サンゴ礁イニシアティブ（ICRI）による対応

1. 世界のサンゴ礁白化現象の経過

世界規模白化現象の背景

◆2014年6月：「エルニーニョ注意報（Watch）」

- 2014年下旬までに小～中規模のエルニーニョが起こると予測
- 数ヵ月高水温が続くが、エルニーニョ現象は確認されず、拡散

◆2015年上旬：「エルニーニョ注意報（Advisory）」

- エルニーニョ現象を確認・継続すると予測
- 北部太平洋で異常な暖水塊「Blob」が出現
- 下旬にエルニーニョ現象がピークに

◆2016年4月：まだ「エルニーニョ注意報（Advisory）」継続

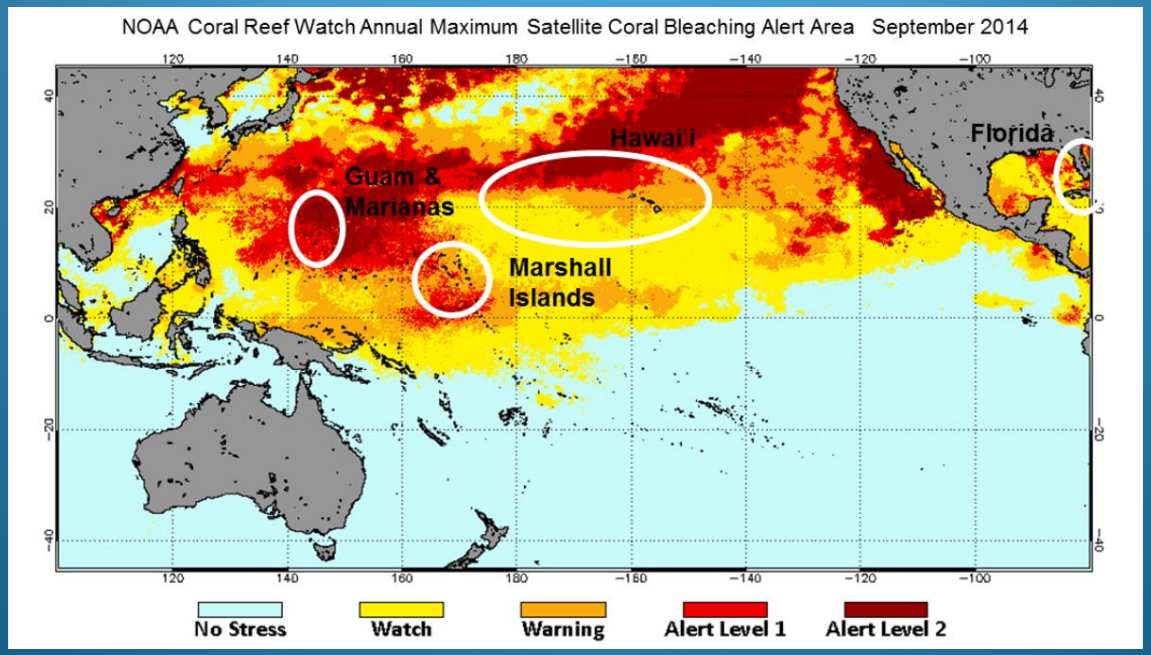
- エルニーニョ現象を確認・継続すると予測
- 2016年下旬にミクロネシアやパラオでラニーニャが起こる「ラニーニャ注意報（Watch）」発令

（"Progression of the Ongoing Global Coral Bleaching Event", Coral Reef Watch, NOAA)より抜粋

世界の白化現象

◆2014年：初期

- 6月：通常はエルニーニョでも高水温にならないグアム・北マリアナ諸島
- 9～10月：ハワイで大規模な白化現象
- 9月：大西洋で白化現象（フロリダ・フロリダキーズ）
- 11月：マーシャル諸島で白化

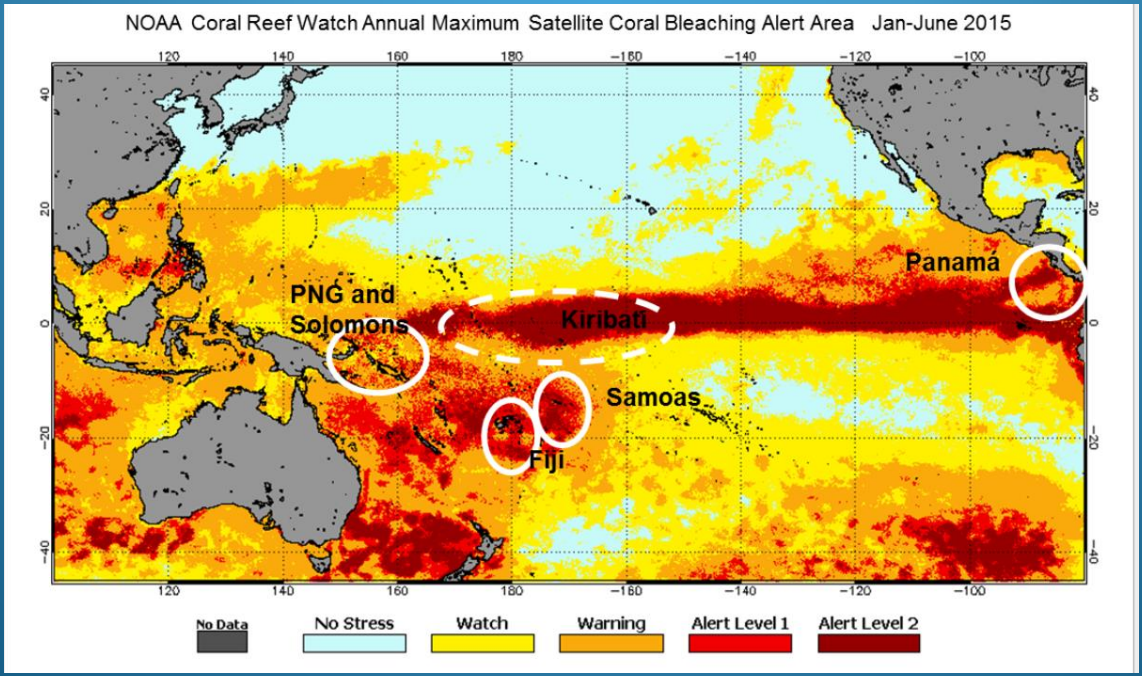


(“Progression of the Ongoing Global Coral Bleaching Event”, Coral Reef Watch, NOAA)より抜粋

世界の白化現象

◆2015年1～6月：拡大期

- 初め：PNG・ソロモン諸島・フィジー・サモア
- 前半：インド洋に拡大（チャゴス諸島・モルジブ）・インドネシア西部・紅海南部
- 中期：パナマ・キリバス・ライン諸島

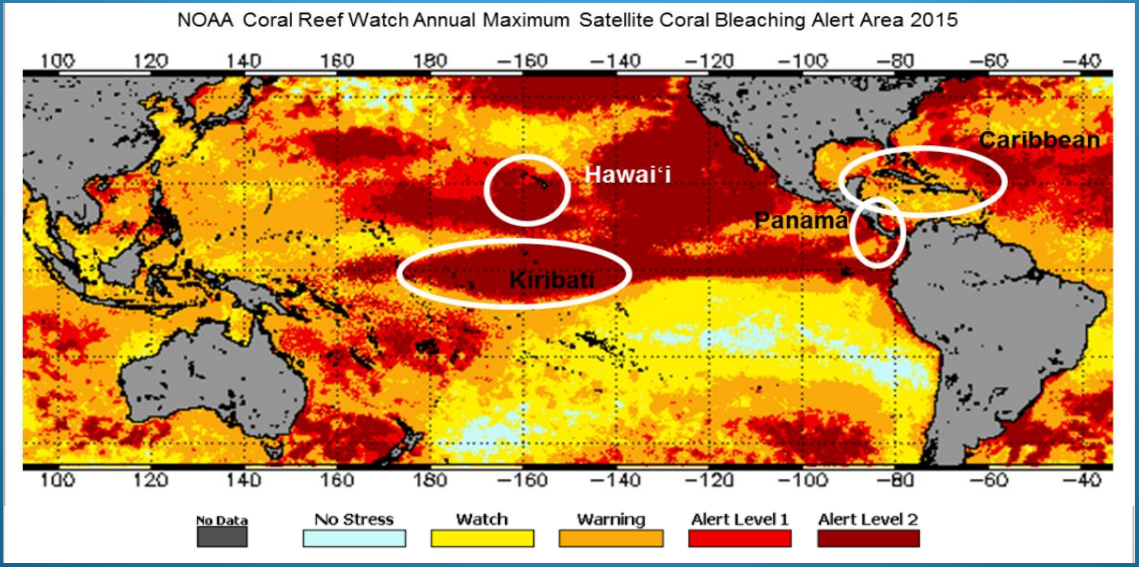


（"Progression of the Ongoing Global Coral Bleaching Event", Coral Reef Watch, NOAA）より抜粋

世界の白化現象（続き）

◆2015年7～12月：最盛期（11-12月：エルニーニョピーク）

- フェニックス諸島・ライン諸島・キリバス
- ハワイ（2年連続で大規模な白化現象）
- カリブ海（バハマ・タークス＆カイコス諸島・ケイマン諸島・ドミニカ共和国・ハイチ・ボネール島）
- フロリダ・フロリダキーズでは白化とホワイトシンドローム大発生

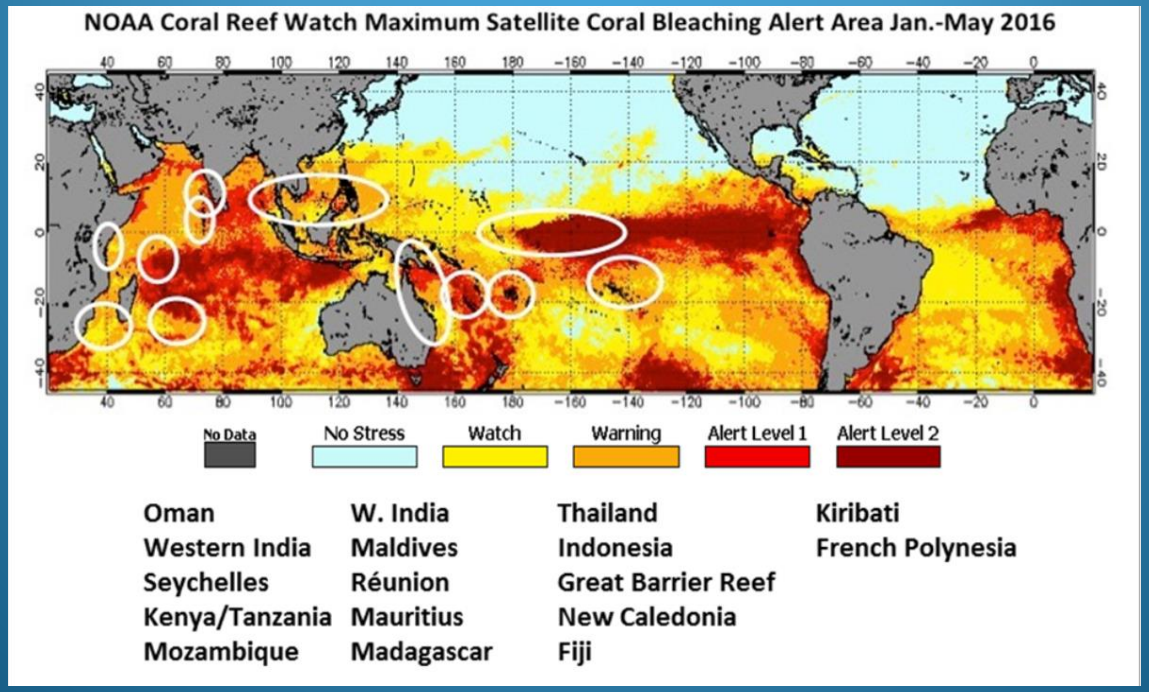


（"Progression of the Ongoing Global Coral Bleaching Event", Coral Reef Watch, NOAA）より抜粋

世界の白化現象（続き）

◆2016年1～5月：継続期（南半球夏季）

- タンザニア・フレンチポリネシア
- グレートバリアリーフ北部（過去最大規模：95%のサンゴ礁）
- ニューカレドニア・フィジー
- キリバス（死亡：80%以上、白化：15%）



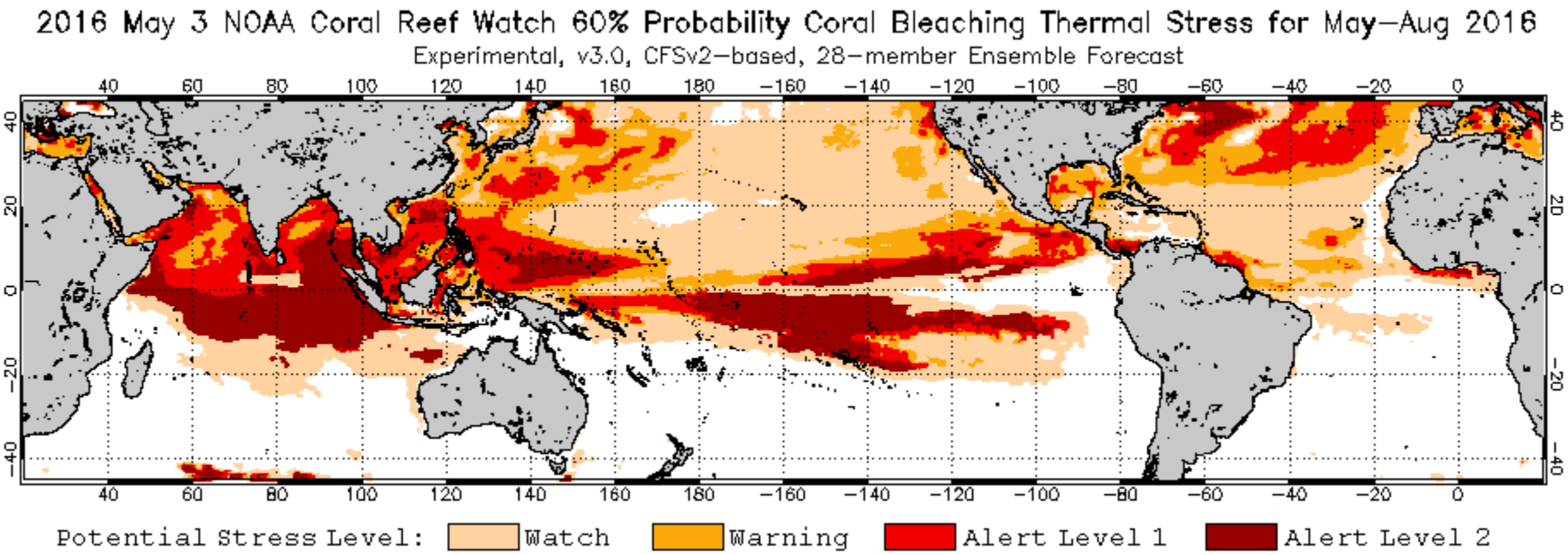
（"Progression of the Ongoing Global Coral Bleaching Event", Coral Reef Watch, NOAA)より抜粋

世界の白化現象（続き）

◆2016年6～8月：継続期（北半球夏季）

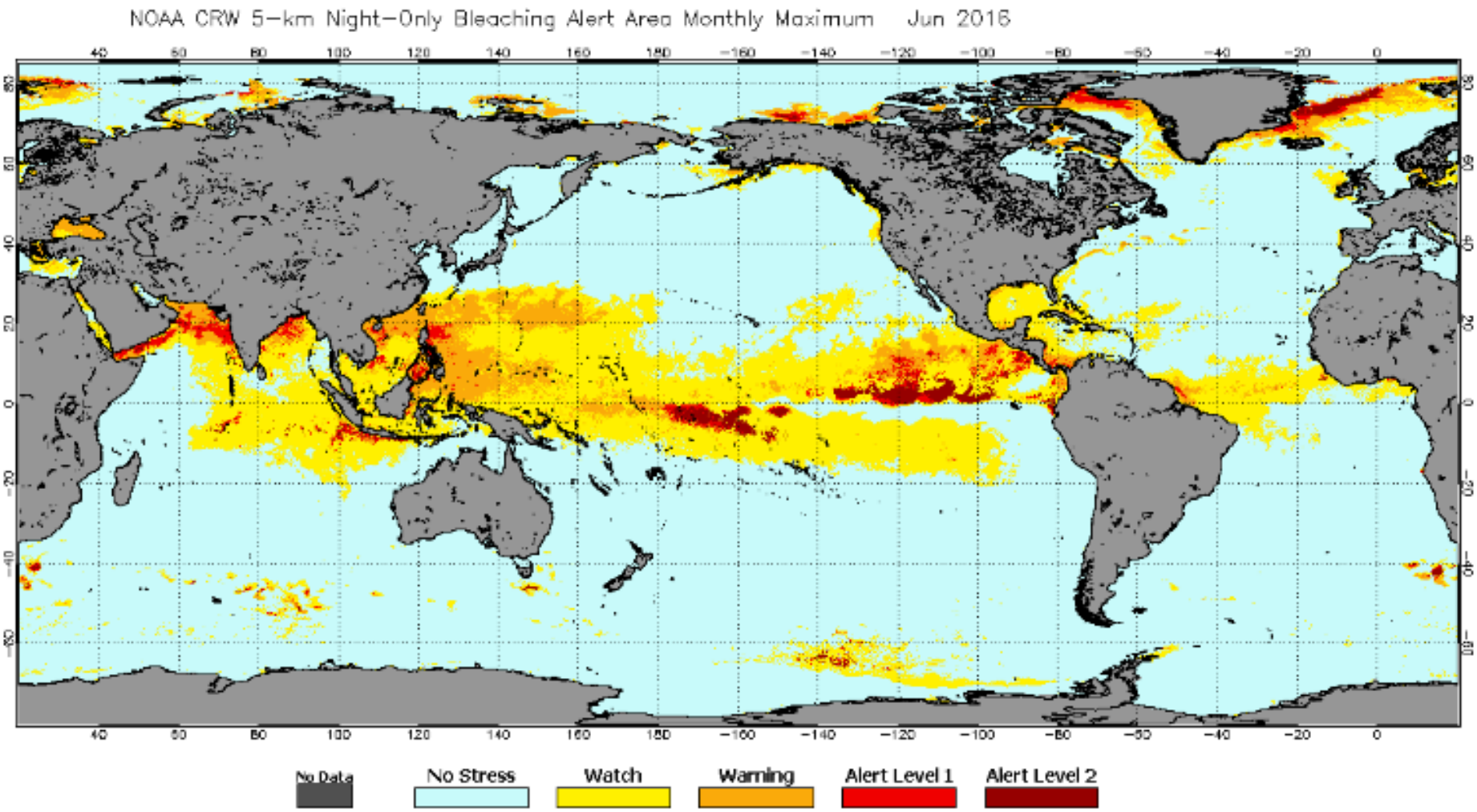
- インド洋北部・東南アジア・東部熱帯太平洋・カリブ海で白化の可能性
- 日本（宮古島・石垣島・石西礁湖・西表島）で大規模な白化

（情報収集中のため被害状況は未確定）

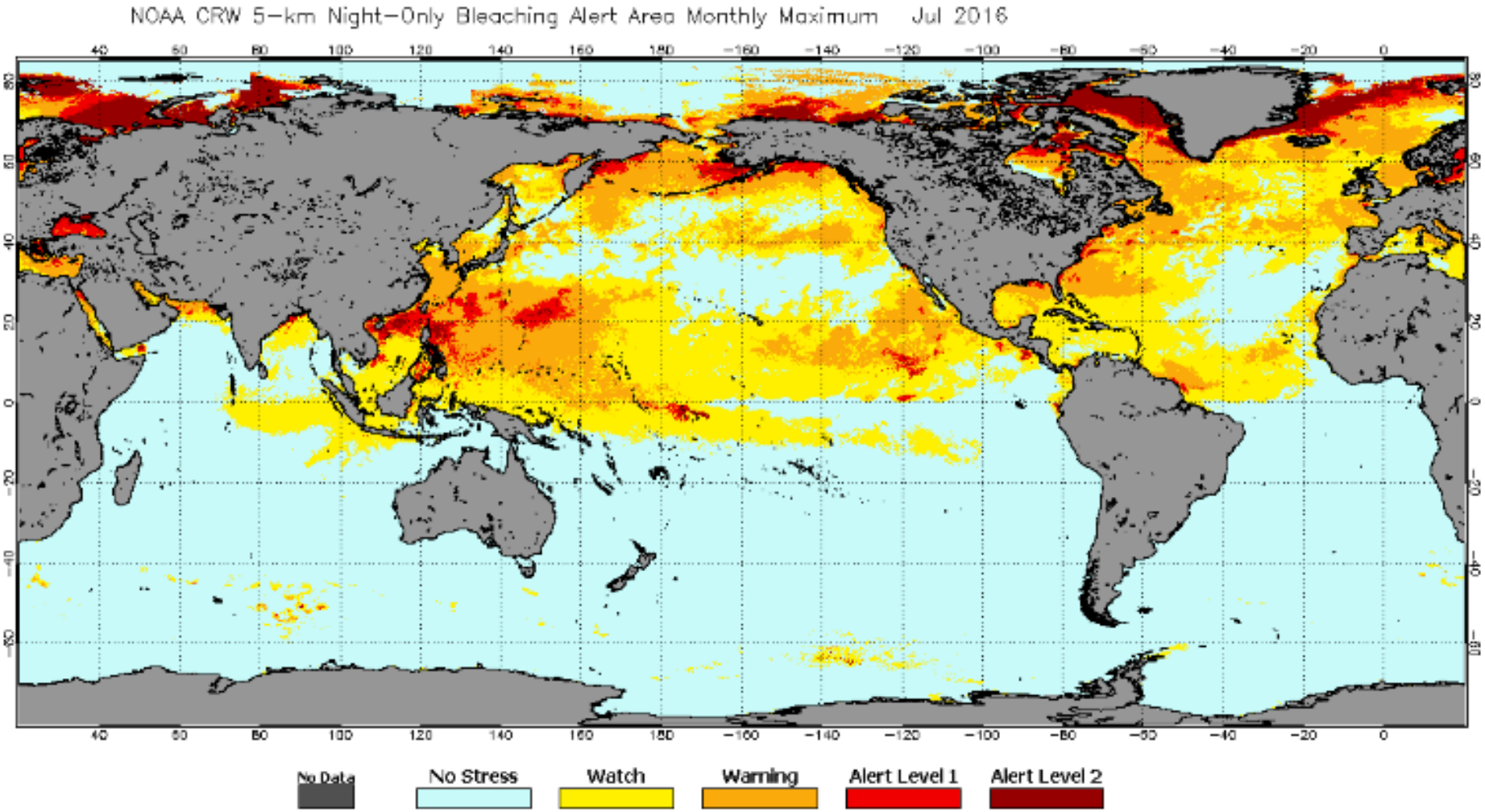


（"Progression of the Ongoing Global Coral Bleaching Event", Coral Reef Watch, NOAA）より抜粋

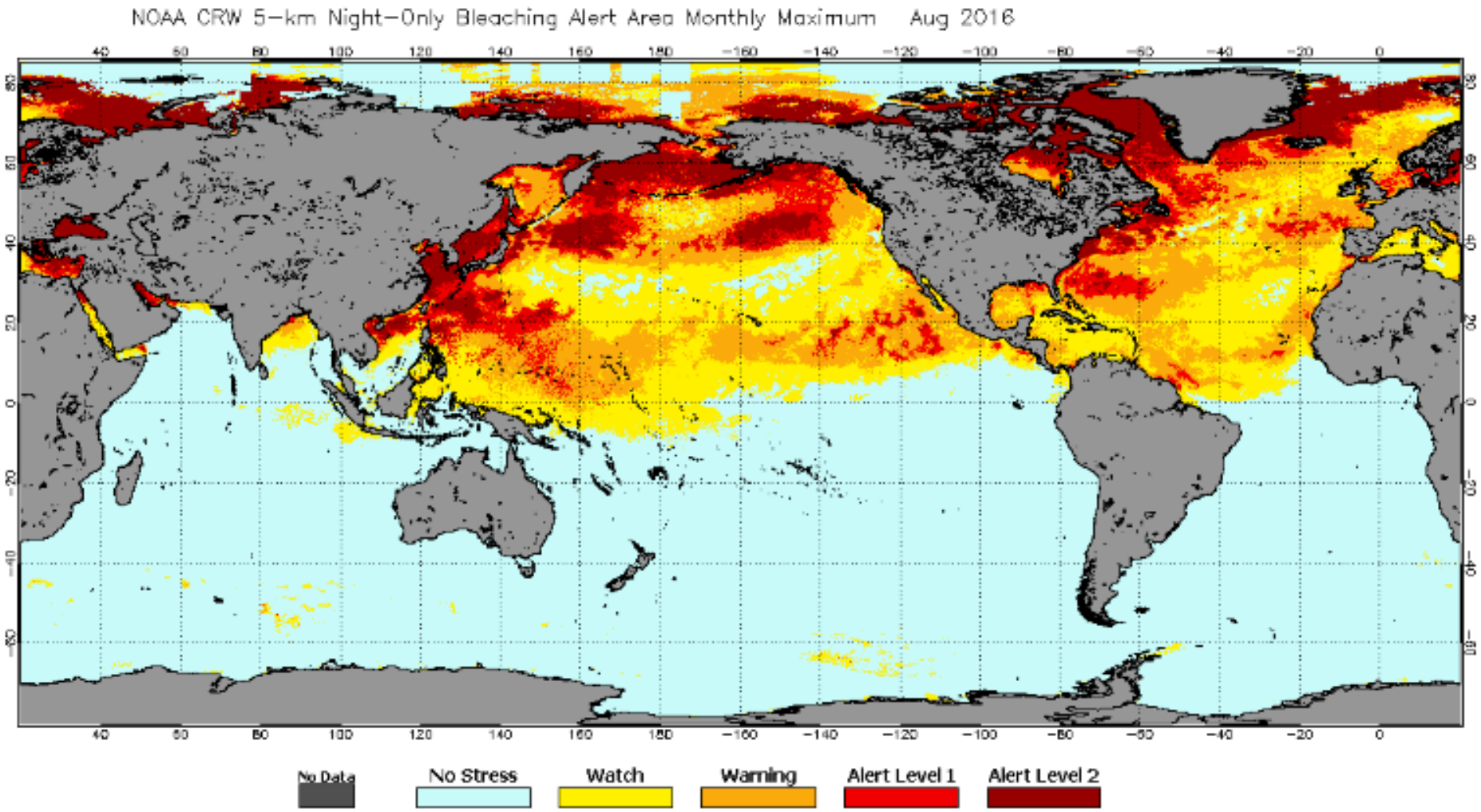
◆2016年6月


NOAA CRW 5-km Night-Only Bleaching Alert Area Monthly Maximum Jun 2016
No Data
No Stress
Watch
Warning
Alert Level 1
Alert Level 2

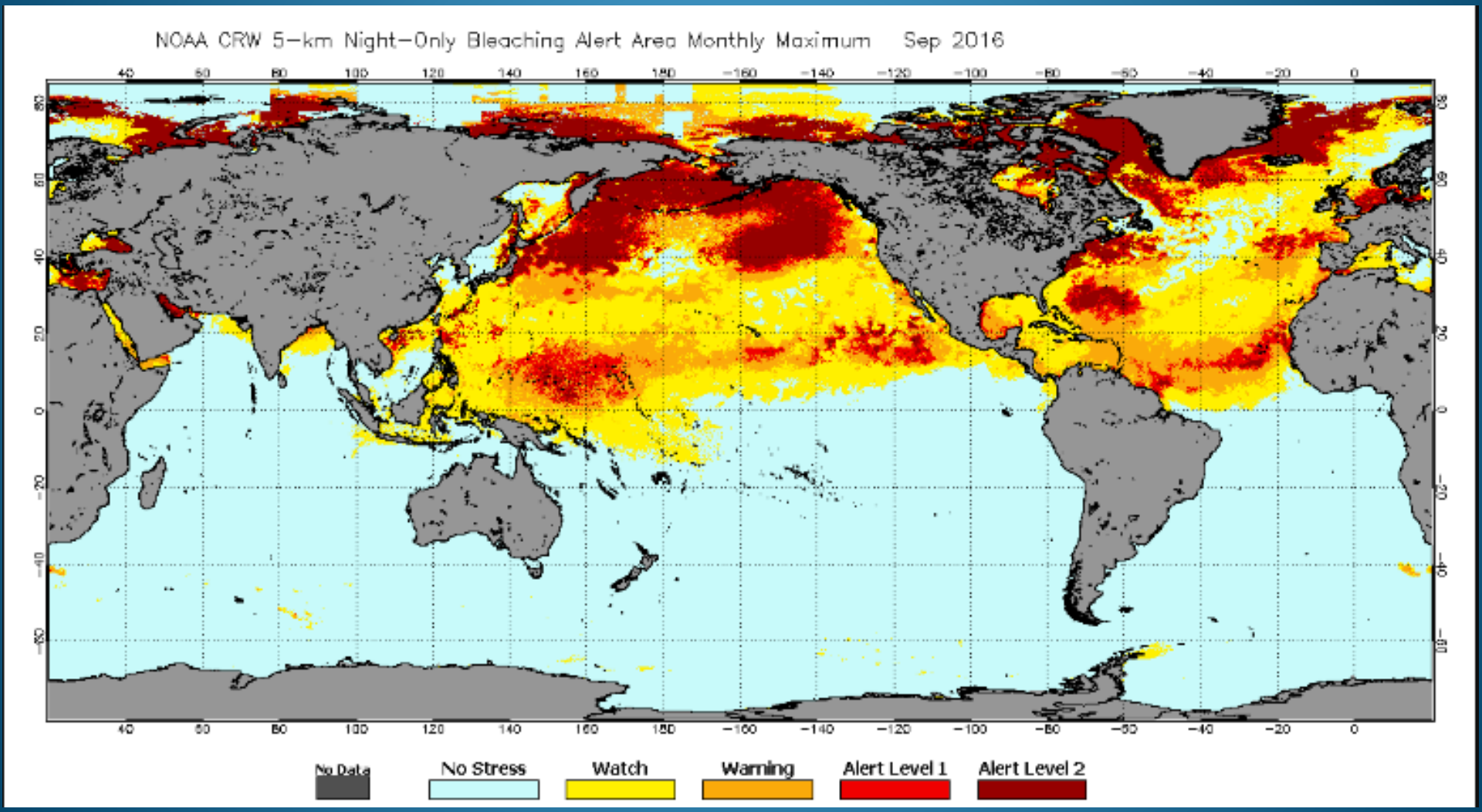
◆2016年7月


NOAA CRW 5-km Night-Only Bleaching Alert Area Monthly Maximum Jul 2016
No Data
No Stress
Watch
Warning
Alert Level 1
Alert Level 2

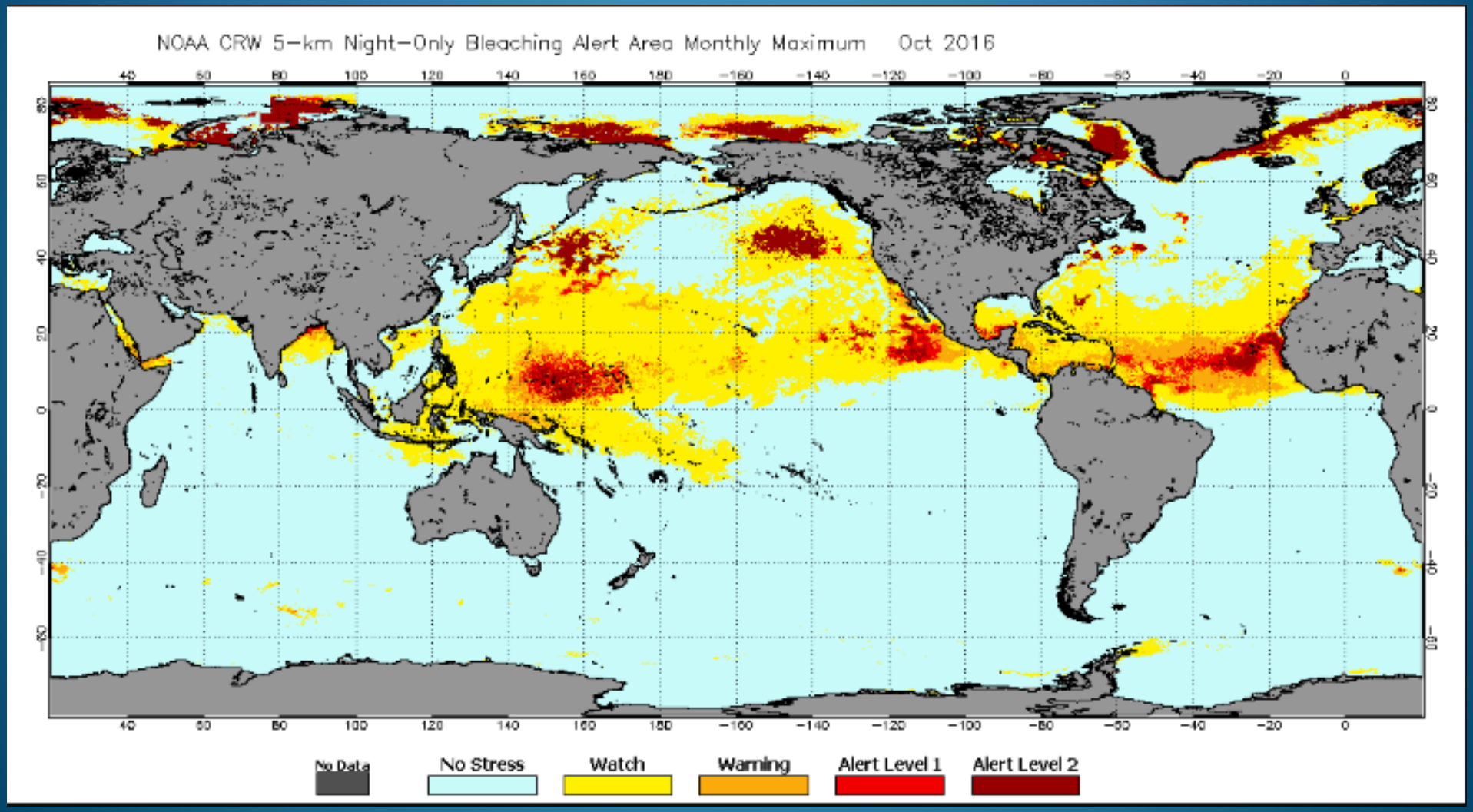
◆2016年8月


NOAA CRW 5-km Night-Only Bleaching Alert Area Monthly Maximum Aug 2016
No Data
No Stress
Watch
Warning
Alert Level 1
Alert Level 2

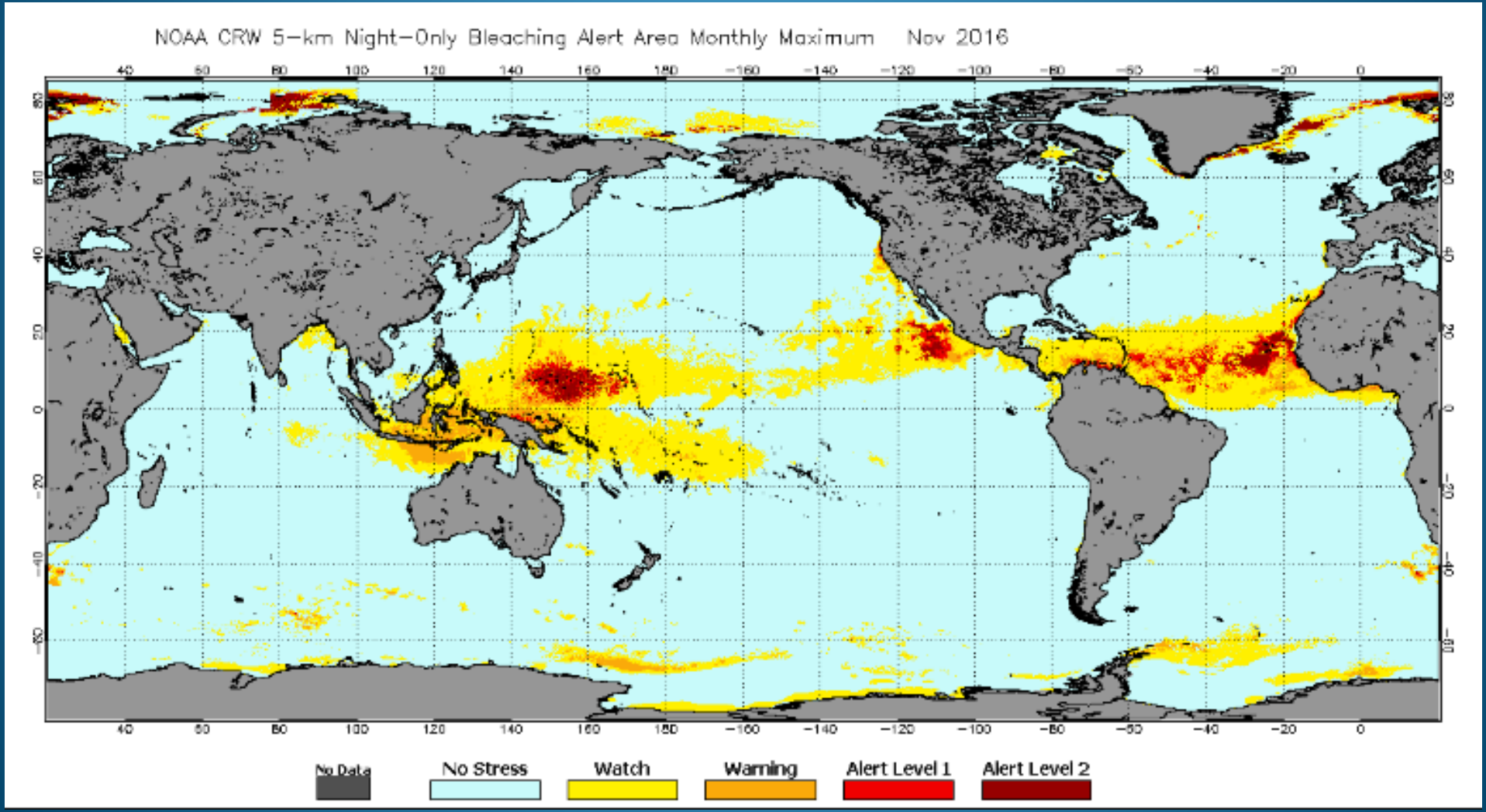
◆2016年9月


NOAA CRW 5-km Night-Only Bleaching Alert Area Monthly Maximum Sep 2016
No Data
No Stress
Watch
Warning
Alert Level 1
Alert Level 2

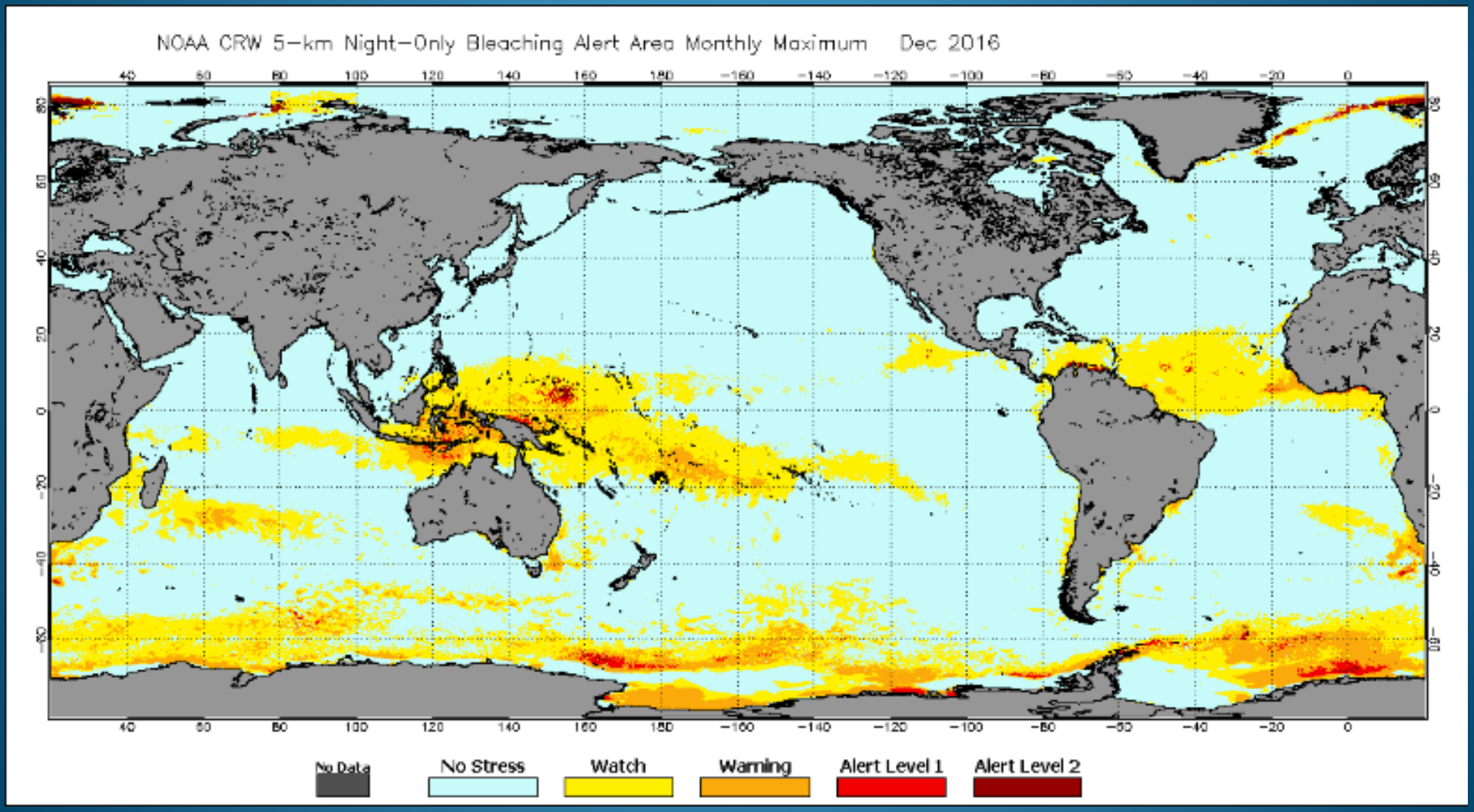
◆2016年10月


NOAA CRW 5-km Night-Only Bleaching Alert Area Monthly Maximum Oct 2016
No Data
No Stress
Watch
Warning
Alert Level 1
Alert Level 2

◆2016年11月


NOAA CRW 5-km Night-Only Bleaching Alert Area Monthly Maximum Nov 2016
No Data
No Stress
Watch
Warning
Alert Level 1
Alert Level 2

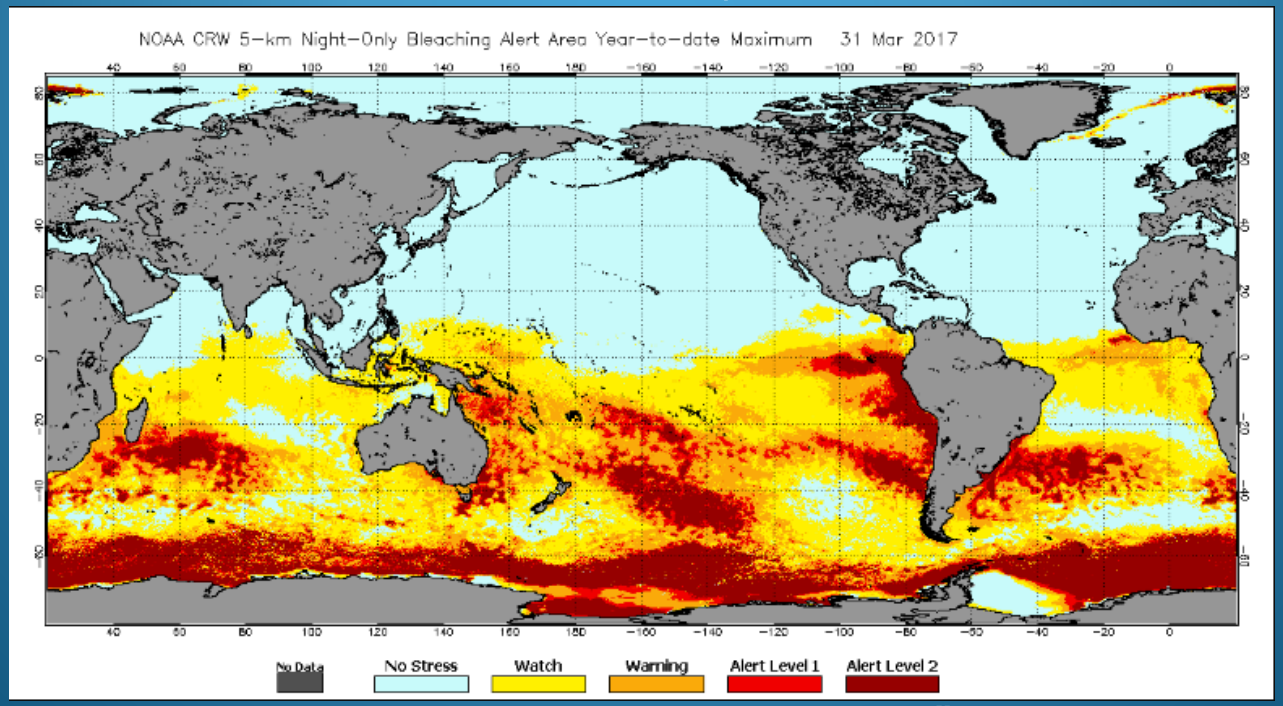
◆2016年12月


NOAA CRW 5-km Night-Only Bleaching Alert Area Monthly Maximum Dec 2016
No Data
No Stress
Watch
Warning
Alert Level 1
Alert Level 2

世界の白化現象（続き）

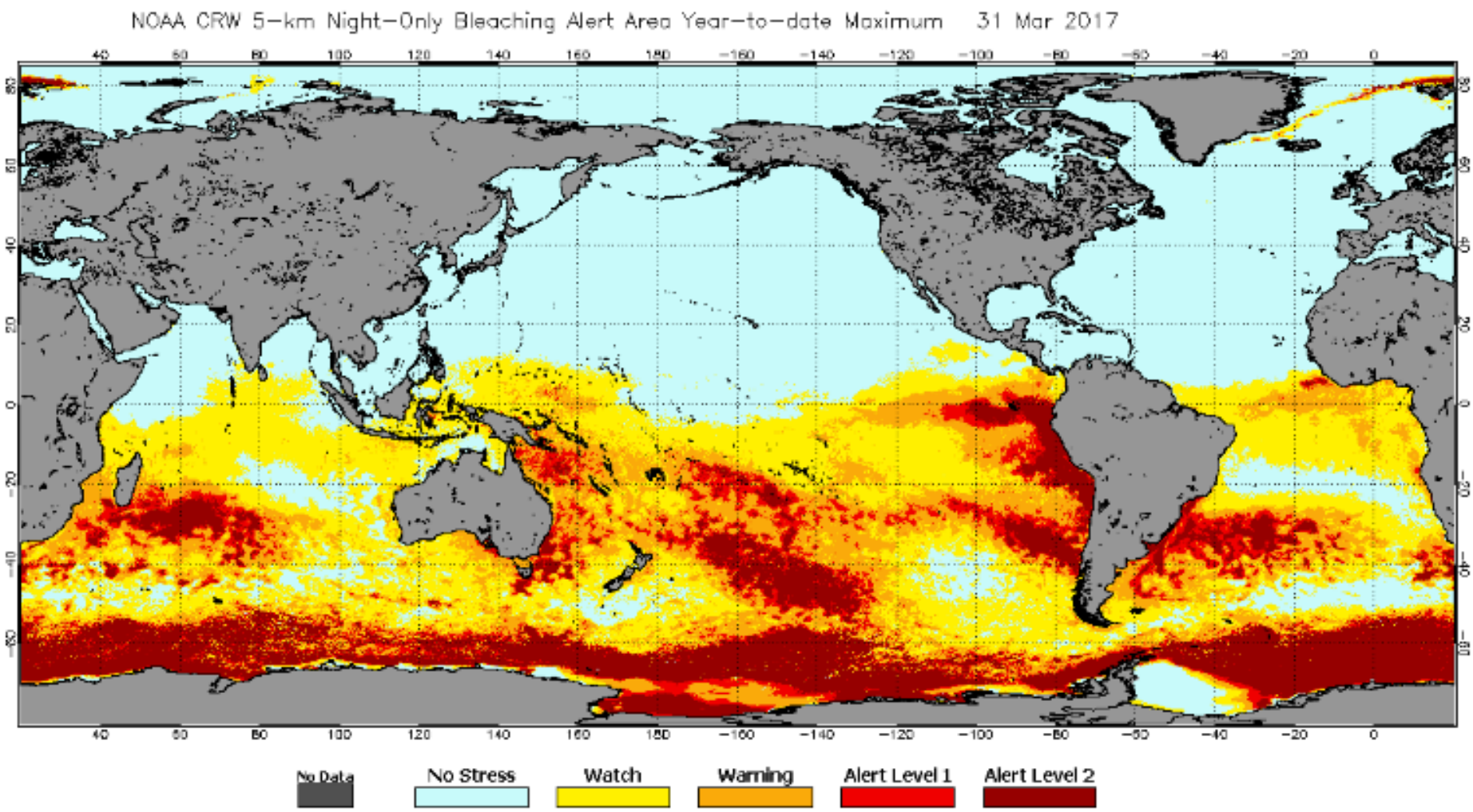
◆2017年1～3月：継続期

- インド洋で再び高水温
- 西インド洋では白化注意報（Bleaching Watch）あるいは水温ストレスなし
- ケニヤは白化警報（Bleaching Warning）
- フロリダ及びフロリダキーズで白化警報→メキシコ湾・ユカタン半島



（"Progression of the Ongoing Global Coral Bleaching Event", Coral Reef Watch, NOAA）より抜粋

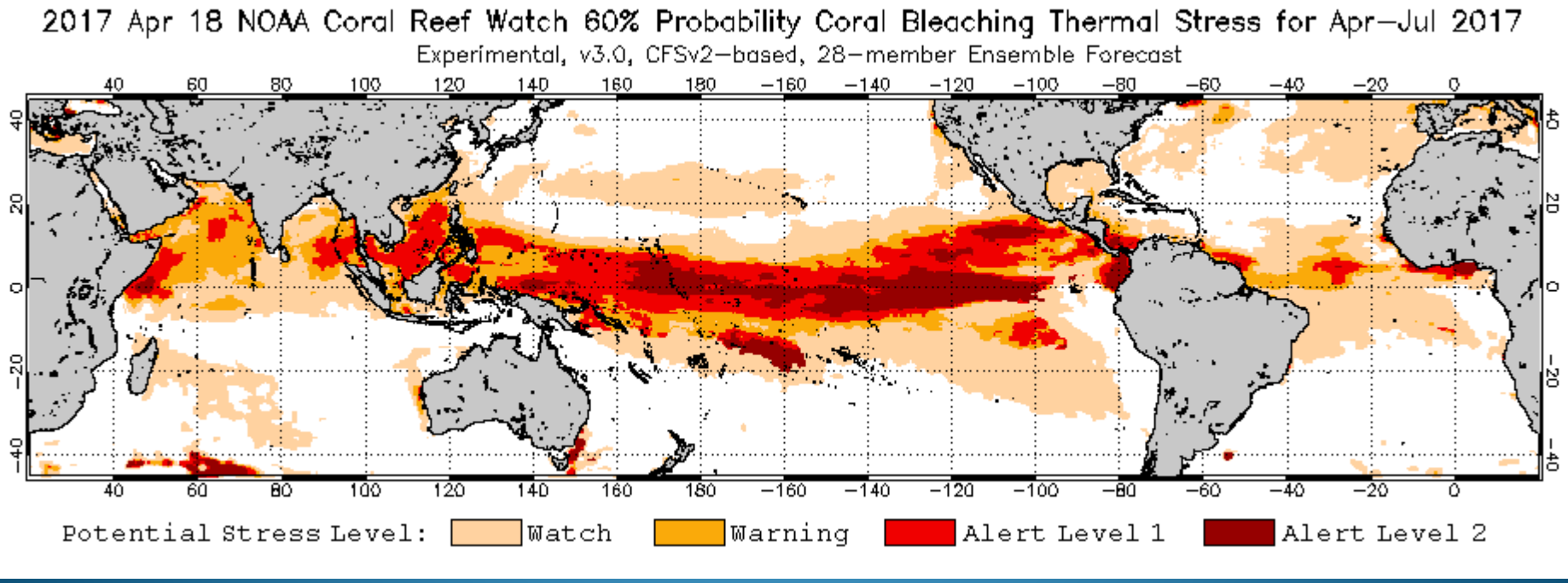
◆2017年1～3月



(“Progression of the Ongoing Global Coral Bleaching Event”, Coral Reef Watch, NOAA)より抜粋

2017年4月現在

◆2017年4月：まだ白化現象進行中



2014-2017年地球規模白化現象

◆2014年の高水温＋2015～2016年の強度のエルニーニョ

◆最も長期的（2～3年：2014-2016 or 2014-2017）

◆最も広範囲

◆最も被害が大きい

◆過去の世界規模白化現象（1998年、2010年）より多くのサンゴ礁が被害

◆過去に白化現象が起こらなかったサンゴ礁でも白化

2. 白化レポート：白化状況のとりまとめ

大規模白化現象についてのレポート

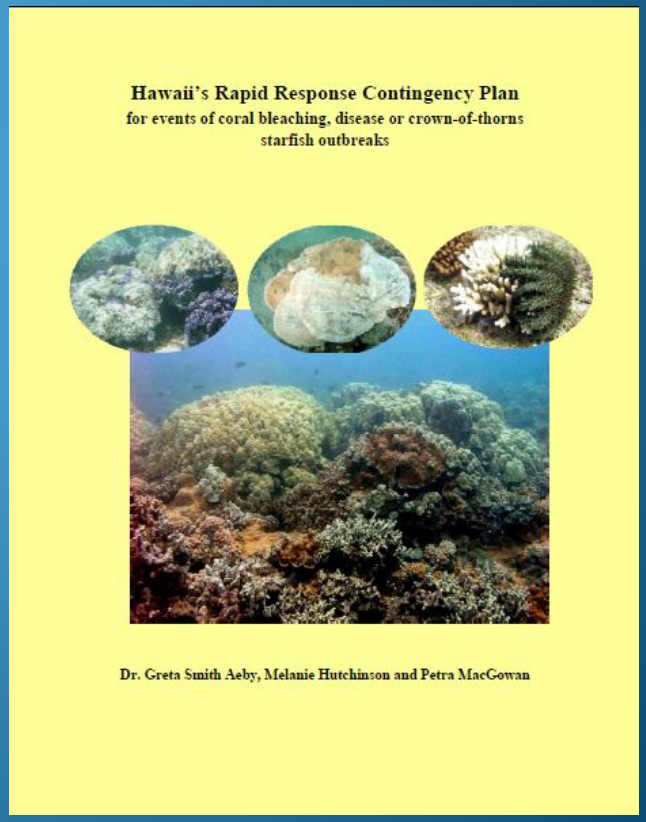
- NOAA：世界各国の白化情報の取りまとめ
- GCRMN（世界）：未定
- 〃 （インド洋）：CORDIOが中心にとりまとめ
- 〃 （南太平洋）：フランスが中心にとりまとめ
- 〃 （東アジア）：日本/シンガポールが中心にとりまとめ

3. 各国の対応

ハワイの白化対応計画

◆緊急対策計画（2008）

- 対象：白化・病気・オニヒトデ大発生
- 関係者によるワークショップの開催（研究者・管理者）
- 管理計画策定
  - 保全管理の枠組み構築
  - モニタリング/監視体制の構築
  - 管理方法・対策方法（保護区・陸域対策・普及啓発）
  - 枠組み



◆緊急対策計画のためのワークショップ（2008年）

Final Report
on
Responding to Climate Change:
A Workshop for Coral Reef Managers

Kaneohe Bay, Hawaii
September 2-5, 2008

By

Britt Parker
NOAA Coral Reef Watch
C. Mark Eakin
NOAA Coral Reef Watch
Christy Loper
NOAA Coral Reef Conservation Program
Kimo Carvalho
NOAA Papahānaumokuākea Marine National Monument

November 2008

Responding to Climate Change Workshop Summary

Written By: Carlie Wiener

This past week, participants from Oahu, Kauai, Maui, Hawai'i Island, Palau, New Zealand, Washington, Samoa, American Samoa, and Pohnpei joined together to partake in the *Responding to Climate Change* workshop. NOAA's Coral Reef Conservation Program and the Office of National Marine Sanctuaries through the Papahānaumokuākea Marine National Monument worked with the Hawai'i Institute of Marine Biology to train coral reef managers, scientists and community members to address coral bleaching and climate change in their communities. Participants arrived Monday evening on Moku O Lo'e (Coconut Island) and were treated to a relaxing dinner.

Workshop participants from Hawai'i and the Pacific.

Mehanaokalā Hind and Darren King talk about indigenous environmental knowledge.

The first day of the workshop covered topics such as climate change, ocean acidification and mass bleaching. Local case studies were explored including a mass bleaching event in the Papahānaumokuākea Marine National Monument. In addition to these concepts, an introduction to indigenous environmental knowledge was presented by Mehanaokalā Hind looking at the *Kumulipo (mele ko 'ihonua* – a Hawaiian creation or genealogical chant that includes the coral polyp) and a special presentation on predicting seasonal changes and Maori cultural monitoring by special guest Darren King. Participants worked to learn how to develop their own rapid response coral bleaching plan and learned about Hawaii's plan which is currently in place with lead Dr. Greta Aeby. In the evening, participants got to know each other better by talking about where they are from and what they do over dinner.

Participants get to know each other over dinner at the beach house.

On day two of the workshop, participants had an early start where they were treated to an activity at sunrise. Participants were introduced to indigenous ways of knowing and observing weather and seasonal changes. The lectures during the morning continued with assessing ecological impacts, coral resilience and learning to identify coral bleaching. This knowledge was applied in the field while the group got to snorkel in Kāne'ohe Bay; carrying out a group activity examining coral resilience. KHNL news team joined us on our field trip and covered the workshop on their evening news program.

Kāne'ohe Bay sunrise.

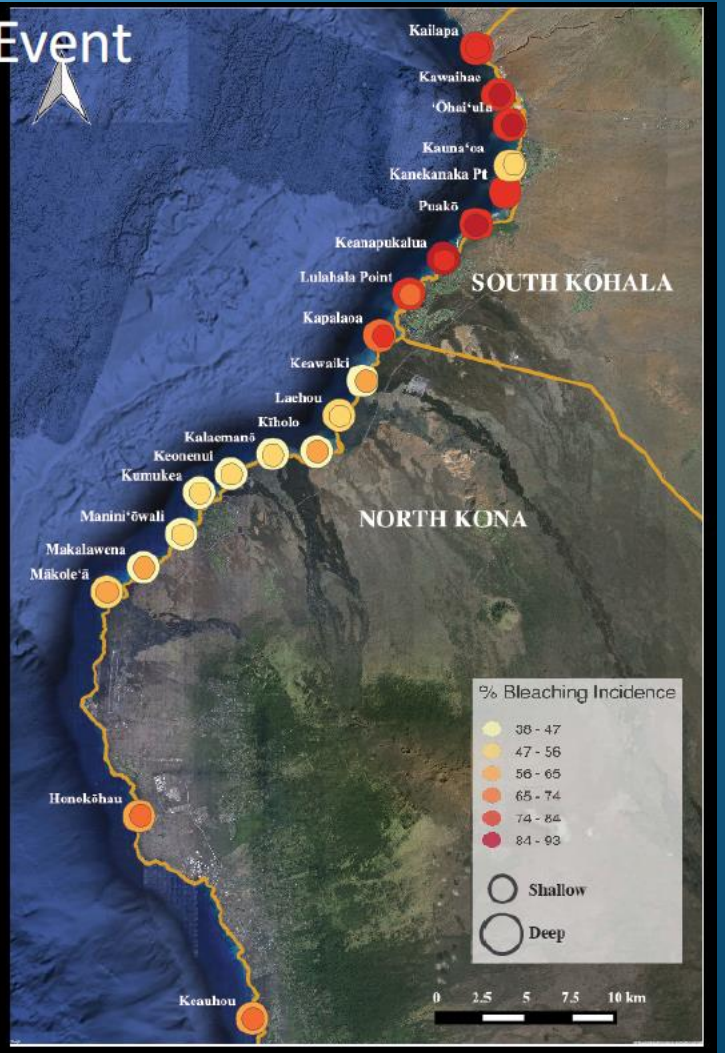
re explains
omment to
seasons.

ing, the group got to learn about a project that included combining both cultural and exes presented by HIMB scientist, Dr. Ku'ulei Rodgers and long time Kāne'ohe resident fishpond executive director, Hi'ilei Kawelo. Later that morning workshop topics moved nic impacts of coral bleaching and climate change. KHON reporters were also present to n the workshop. In the afternoon, breakout groups went outside to carry out a group discussion. Topics of communication strategies and outreach were covered as

◆モニタリング結果：2015年の白化現象

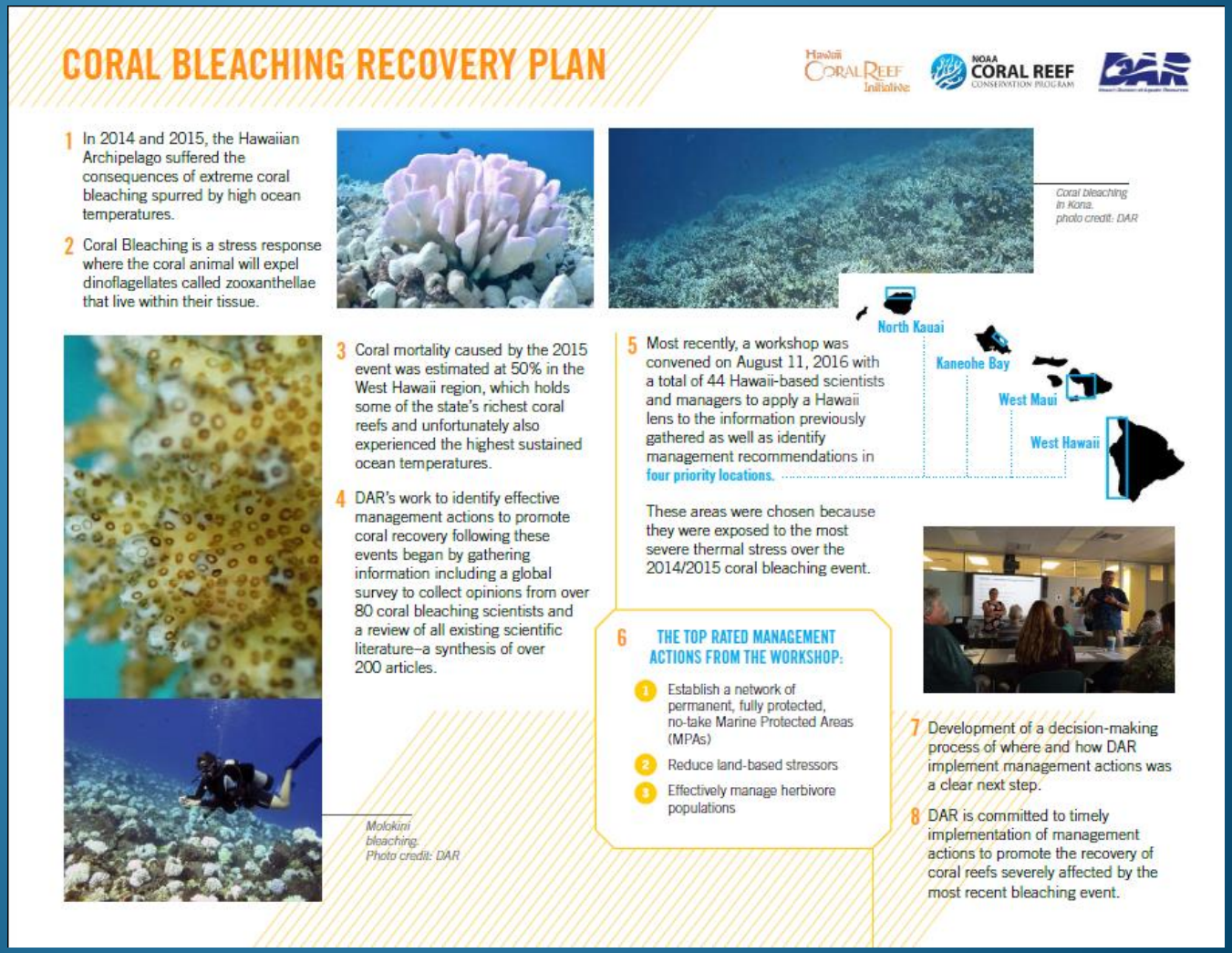
2015 Hawai'i Bleaching Event

- 40 sites surveyed across shallow and deep reefs in October 2015
- 38-92% of all coral colonies partially or fully bleached
- Northern sites had worse bleaching and generally more degraded water quality
- Just completed re-surveys of these sites to track recovery
- Bleaching and resilience assessment results feeding directly into State and community management initiatives



◆サンゴの白化回復計画（2016年）

- MPA
- 陸域対策
- 食植性魚類の管理



CORAL BLEACHING RECOVERY PLAN

Hawaii Coral Reef Initiative · NOAA Coral Reef Conservation Program · DAR

1 In 2014 and 2015, the Hawaiian Archipelago suffered the consequences of extreme coral bleaching spurred by high ocean temperatures.

2 Coral Bleaching is a stress response where the coral animal will expel dinoflagellates called zooxanthellae that live within their tissue.

Coral bleaching in Kona. photo credit: DAR

3 Coral mortality caused by the 2015 event was estimated at 50% in the West Hawaii region, which holds some of the state's richest coral reefs and unfortunately also experienced the highest sustained ocean temperatures.

4 DAR's work to identify effective management actions to promote coral recovery following these events began by gathering information including a global survey to collect opinions from over 80 coral bleaching scientists and a review of all existing scientific literature–a synthesis of over 200 articles.

Molokini bleaching. Photo credit: DAR

5 Most recently, a workshop was convened on August 11, 2016 with a total of 44 Hawaii-based scientists and managers to apply a Hawaii lens to the information previously gathered as well as identify management recommendations in four priority locations.

North Kauai · Kaneohe Bay · West Maui · West Hawaii

These areas were chosen because they were exposed to the most severe thermal stress over the 2014/2015 coral bleaching event.

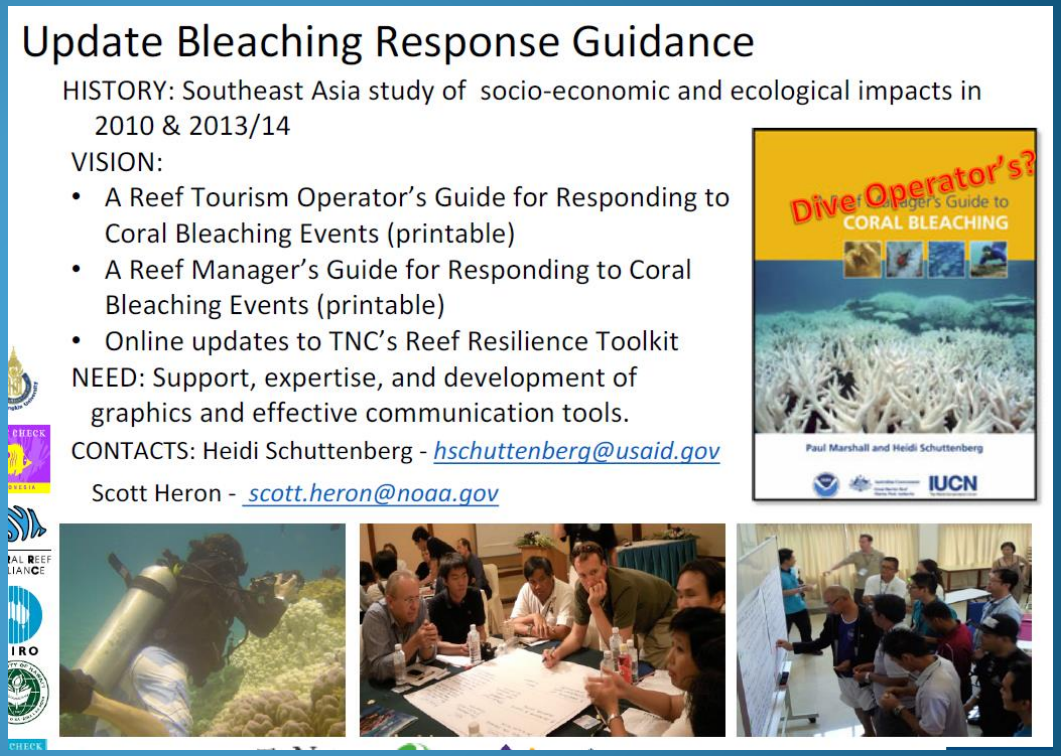
6 THE TOP RATED MANAGEMENT ACTIONS FROM THE WORKSHOP:

1. Establish a network of permanent, fully protected, no-take Marine Protected Areas (MPAs)
2. Reduce land-based stressors
3. Effectively manage herbivore populations

7 Development of a decision-making process of where and how DAR implement management actions was a clear next step.

8 DAR is committed to timely implementation of management actions to promote the recovery of coral reefs severely affected by the most recent bleaching event.

IUCNの白化対応ガイダンス



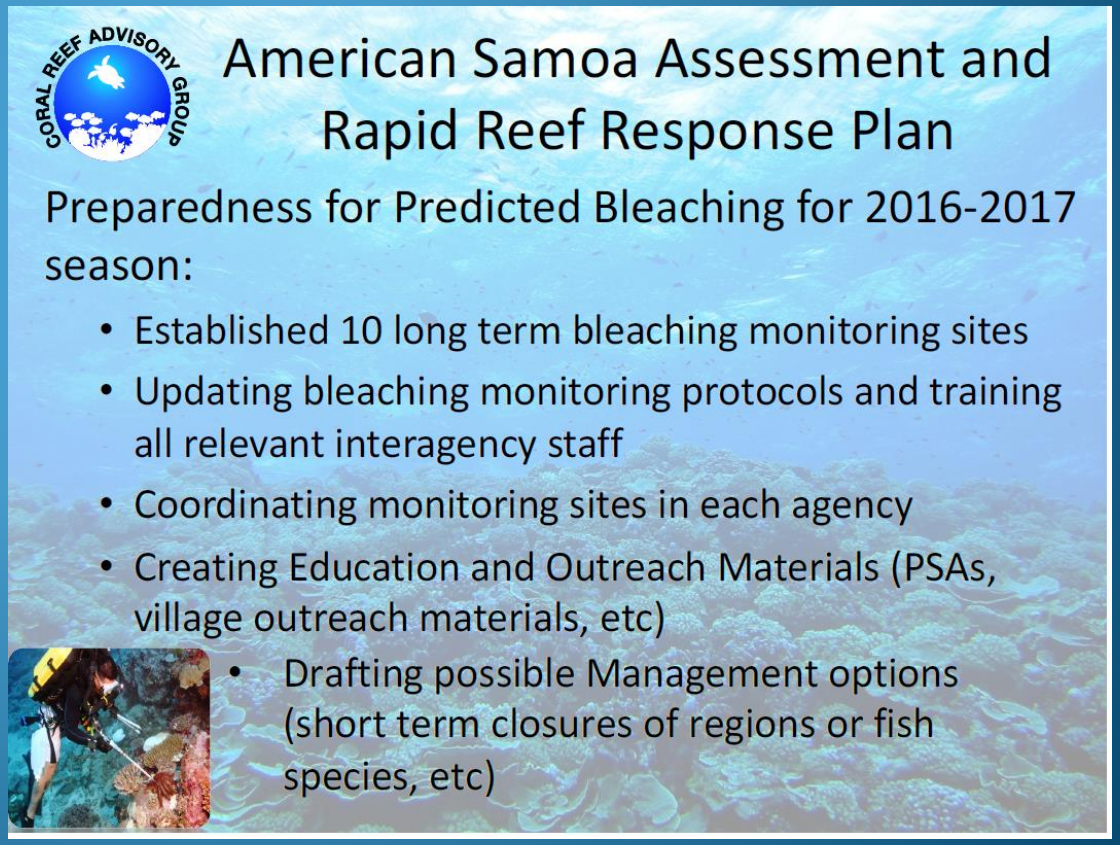
- ツアーガイド用
- サンゴ礁管理者用
- サンゴ礁レジリアンス強化のためのツールキット

アメリカ領サモアの白化対応計画

◆2016–17年の白化への準備

- 長期モニタリング
- 調査手法研修
- 教育・普及啓発
- 管理方法の検討

（保護区等）



オーストラリアの白化対応計画

◆2007～2008年

- 緊急連絡体制
- 調査・影響評価
- 情報提供システム

◆2010～2011年

- 緊急連絡体制
- 保全対策

（人為的ストレス軽減・気候変動普及啓発等）

- 情報提供システム

オーストラリアの白化対応計画

◆2015～2016年

- The Northern Great Barrier Reef Response Plan
- 現状報告＋回復計画
- UNESCO世界遺産委員会への報告
- 過去最大規模の被害
- レジリアンスの強化

オーストラリアの白化対策行動

◆温室効果ガスの削減

◆水質の向上

◆沿岸生態系の保全

◆生物多様性の保全

◆サンゴ群集の保護

- 食害生物からの保護
- 物理的破壊からの保護

◆サンゴ礁の回復促進

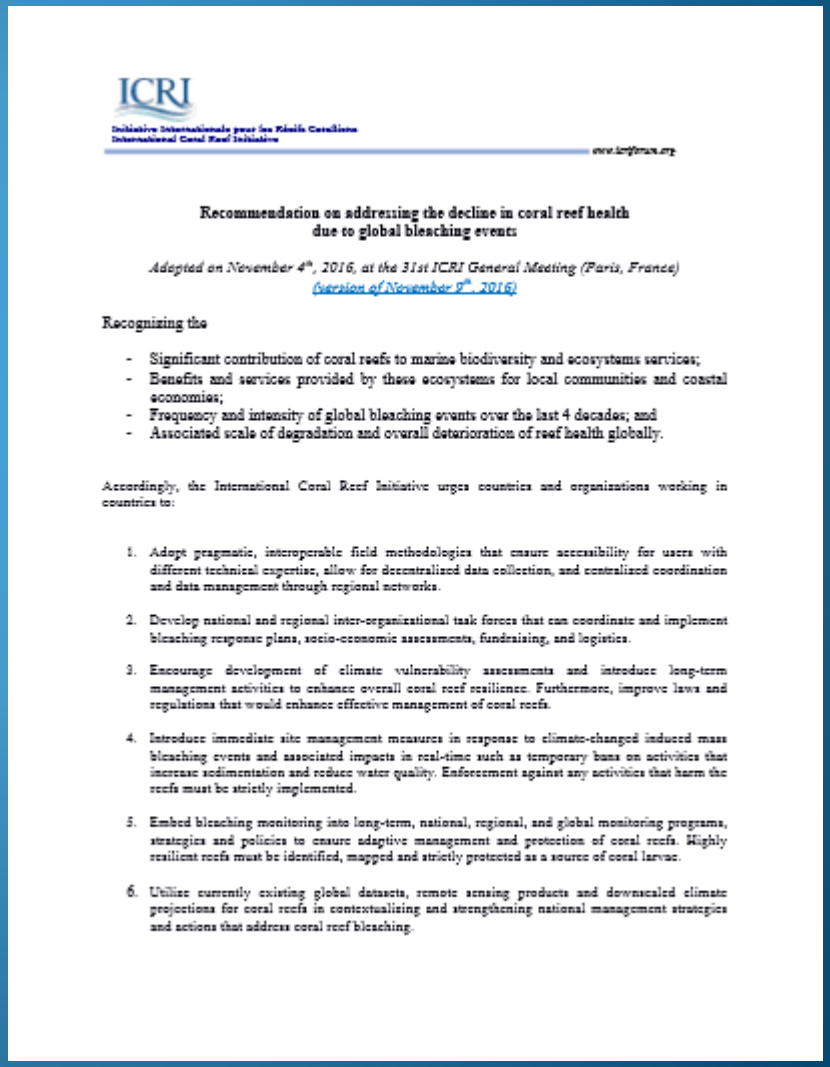
- レジリアンスの強化

4. 国際サンゴ礁イニシアティブ（ICRI）による対応

ICRIの対応

◆白化についての勧告

- 情報収集体制構築
- 緊急対策チーム体制構築
- 長期的レジリアンス促進対策
- 長期的モニタリング体制
- 国家戦略における白化対策



ICRI

Initiative Internationale pour les Récifs Coralliens
International Coral Reef Initiative

www.icriforum.org

Recommendation on addressing the decline in coral reef health due to global bleaching events

Adopted on November 4th, 2016, at the 31st ICRI General Meeting (Paris, France)
(version of November 9th, 2016)

Recognizing the

- Significant contribution of coral reefs to marine biodiversity and ecosystems services;
- Benefits and services provided by these ecosystems for local communities and coastal economies;
- Frequency and intensity of global bleaching events over the last 4 decades; and
- Associated scale of degradation and overall deterioration of reef health globally.

Accordingly, the International Coral Reef Initiative urges countries and organizations working in countries to:

1. Adopt pragmatic, interoperable field methodologies that ensure accessibility for users with different technical expertise, allow for decentralized data collection, and centralized coordination and data management through regional networks.
2. Develop national and regional inter-organizational task forces that can coordinate and implement bleaching response plans, socio-economic assessments, fundraising, and logistics.
3. Encourage development of climate vulnerability assessments and introduce long-term management activities to enhance overall coral reef resilience. Furthermore, improve laws and regulations that would enhance effective management of coral reefs.
4. Introduce immediate site management measures in response to climate-changed induced mass bleaching events and associated impacts in real-time such as temporary bans on activities that increase sedimentation and reduce water quality. Enforcement against any activities that harm the reefs must be strictly implemented.
5. Embed bleaching monitoring into long-term, national, regional, and global monitoring programs, strategies and policies to ensure adaptive management and protection of coral reefs. Highly resilient reefs must be identified, mapped and strictly protected as a source of coral larvae.
6. Utilize currently existing global datasets, remote sensing products and downscaled climate projections for coral reefs in contextualizing and strengthening national management strategies and actions that address coral reef bleaching.

ICRIの対応

◆国際サンゴ礁年2018についての決議

- サンゴ礁の価値の認識
- 政府、民間、研究者、市民の連携
- 生態系のレジリアンス増強及び持続的利用に関する効果的な保全戦略
- 持続的サンゴ礁管理についての情報の共有

ICRI
Initiative Internationale pour les Récifs Coralliens
International Coral Reef Initiative
www.icriforum.org

Recommendation designating 2018 as the third International Year of the Reef

Adopted on November 4th, 2016, at the 31st ICRI General Meeting (Paris, France)

Acknowledging that coral reefs are now one of the most threatened ecosystems on the planet, as a result of both climate change, which triggered the 2014/2016 coral bleaching event (the most severe ever recorded), and local anthropogenic pressures, but that awareness of this among the general public, as well as decision-makers and civil society, is still insufficient to bring about the required policy, regulatory and public behavioural changes;

Aware that the International Society for Reef Studies, in its Consensus Statement on Climate Change and Coral Bleaching prepared for the UNFCCC COP21 in Paris, December 2015, called for all nations to commit to reducing CO_2 emissions to the point to prevent the global collapse of coral reef ecosystems

Aware that the Call for Action that came out of the Leaders' Summit held at the 13th International Coral Reef Symposium in Hawaii, 2016, put out a challenge to Pacific nations and the global community to, among other things, collaborate and support each other's coral reef stewardship efforts and to leverage new initiatives

Recognizing the success of the 1997 and 2008 International Years of the Reef in raising awareness of the importance of coral reef and associated ecosystems, and the continued need for such activities to create an understanding of the opportunities to further conserve and restore these valuable ecosystems;

Noting that, following IYOR 2008, ICRI adopted a recommendation at the ICRI GM in 2009 on "Continuing Coral Reef Awareness Efforts" which called for ICRI Members and other active participants in IYOR2008 to continue the efforts started in 2008 in terms of strengthening awareness about the value of, and threats to, coral reefs and associated ecosystems; encouraging public involvement in coral reef education and conservation activities; and implementing effective management strategies for conservation, increased resiliency and sustainable use of these ecosystems;

Noting Aichi target 1, "By 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably" as well as "Priority Actions to Achieve Aichi Biodiversity Target 10 for Coral Reefs and Closely Associated Ecosystems" adopted in CBD Decision XII/23 which, inter alia, encourages parties to enhance public awareness of the socio-cultural and environmental values of coral reefs and develop and implement targeted education and awareness campaigns for diverse stakeholders on how communities and stakeholders can increase coral reef resilience;

IYOR 2018
INTERNATIONAL YEAR OF THE REEF


石西礁湖